2005

Ergonomics and the School-Aged Child

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by

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A Scholarly Project

Submitted to the Occupational Therapy Department

of the

University of North Dakota

In partial fulfillment of the requirements

for the degree of

Master's of Occupational Therapy

Grand Forks, North Dakota
May 14, 2005

This Scholarly Project Paper, submitted by Allison Ruff in partial fulfillment of the requirement for the Degree of Master's of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

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Faculty Advisor

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Ergonomics and the School-Aged Child

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CHAPTER ONE

INTRODUCTION

Ergonomics is most commonly defined as designing work, the work environment, or work conditions to prevent injury and promote worker health, safety, productivity, and comfort (Jacobs et al., 2002). Historically, ergonomics has been researched, designed, and applied to the adult workplace. Adults in the workforce are at risk of experiencing injuries and disorders, such as musculoskeletal disorders, cumulative trauma disorders, or computer vision syndrome as a result of their jobs and poor ergonomics. Many of the risk factors affecting the adult workforce are similar to the risk factors affecting children. Theoretically, if an adult experiences injuries and disorders due to poor ergonomics in the workplace, then why would a child not be at risk as well?

If "work" can be viewed as almost any kind of human activity which involves purpose of effort, then wherever there is a person in an environment, ergonomic principles can be applied. Therefore, the work of a child occurs during his or her role as a student in their work environment of a school classroom. A child's work environment is primarily the school environment for at least 9-10 months out of the year on an average of seven hours per day. A child's work occurs within a variety of roles such as a student or an athlete and through various work activities such as doing homework, using a computer, or playing a school sport (Jacobs et al., 2002).

There is considerable research that identifies the risk factors that influence the need to assess, design, and implement ergonomic interventions. This body of research is growing which is resulting in a positive impact on the work environment for the adult worker. The issue is that there is limited research and literature on the general work environment of a child. There is limited occupational therapy literature that examines the effects of poor ergonomics on children and the resultant impact on their learning.

The purpose of this project was to review the current literature to determine if there are any correlations among the commonalities of the adult work environment and the child's work environment. If there was a correlation, it would support the need to develop an occupational therapy protocol that addresses ergonomics in the school system. Information in the literature did provide the necessary information to make a correlation and the result was the development of an Occupational Therapy (OT) ergonomic protocol specific for the needs of children.

The OT protocol is designed to assist an occupational therapist with the evaluation and implementation of an ergonomics program. Direct intervention and educational approaches are included that focus on the school educators, parents, and students regarding the importance of implementing ergonomics into a child's work environment. The protocol is generalized for school-aged children but since every child is different developmentally and has different ergonomic needs, the protocol needs to be modified to meet each child's individual needs. The OT protocol is designed to serve as a guide for occupational therapists who are taking a proactive, preventive approach to educate and communicate to others the need for implementing ergonomic principles at a

young age (Jacobs et al., 2002). Additional resources are provided to assist the OT to design individualized interventions.

Key concepts and terminology that will be used throughout the document include:

1. Physical Ergonomic Domain – concerned with human anatomy, anthropometry, physiological, and biomechanical characteristics as they relate to physical activity (International Ergonomics Association, 2005). The areas covered include work postures, handling materials, repetitive movements, work related musculoskeletal disorders, workplace layout, safety, and health.
2. Cognitive Ergonomic Domain – considers the human mental processes, such as perception, memory, reasoning, and motor responses, and how they affect the interactions between humans and other elements of a system (International Ergonomics Association, 2005). The areas covered include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as they relate to the human-system design.
3. Organizational Ergonomic Domain – concerned about optimizing the organizational structures, policies, and processes (International Ergonomics Association, 2005). The areas covered include communication, crew resource management, work design, design of working times, teamwork, community ergonomics, cooperative work, virtual organizations, and quality management.
4. Risk Factors – an attribute, experience, or exposure that increases the probability of a disease or disorder though it is not necessarily a casual factor (Matoushek, 2002).

5. Musculoskeletal disorders (MSDs) – injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage and spinal discs (Occupational Safety & Health Administration, 2003).
6. Cumulative Trauma Disorders (CTD) – injuries of the musculoskeletal and nervous systems that may be caused by repetitive tasks, forceful exertions, vibrations, mechanical compression, or sustained or awkward positions from jobs, sports, and hobbies (New Jersey Department of Health and Senior Services, Public Employees Occupational Safety and Health Program, 1997).
7. Computer Vision Syndrome (CVS) – comprehensive term for eye and vision problems related to near work, which is experienced during or related to computer use (Anshel, 1997-2003).

The scholarly project begins by having chapter two focus on the current literature specific to general ergonomics, then transitioning to ergonomic information specific to the adult workplace, and then the correlation between the adult and the child's work environments is outlined and presented. Chapter two concludes with the proposed idea of the need for an OT protocol. Chapter three provides an overview of the product and its relationship to the literature and knowledge base. It also includes the procedure used in the development of the product/protocol. Chapter four is the protocol in its entirety, which includes all the information regarding evaluation, implementation, education and related forms and resources. The scholarly project ends with chapter five in which recommendations, conclusions, limitations and clinical implications are identified, presented, and discussed.

CHAPTER II

REVIEW OF LITERATURE

Ergonomics is most commonly thought of as designing work, the work environment, or work conditions to prevent injury and promote worker health, safety, productivity, and comfort (Jacobs et al., 2002). There is considerable research that identifies the risk factors that influence the need to assess, design, and implement ergonomic interventions. This body of research is growing which is resulting in a positive impact on the work environment for the adult worker. The issue is that there is limited research and literature on the general work environment of a child.

The work of a child occurs during his or her role as a student in their work environment of a school classroom(s) (Jacobs et al., 2002). Children spend most of their school day in the classroom(s), yet there is limited occupational therapy literature that examines the effects of poor ergonomics on children and the resultant impact on their learning. A literature review was completed to identify research that has been conducted both in and out of the profession of Occupational Therapy regarding classroom ergonomic assessment, design, and implementation of ergonomic intervention for school-aged children.

The review of the literature begins with an introduction to ergonomics, which currently is predominantly focused on the adult work environment. A description of a child's work environment is then introduced to provide a general understanding of their

ergonomic domains, time commitments, work responsibilities, and expectations. The remainder of the literature review focuses on the child's needs, proposed ergonomic application with supportive literature and the role of the occupational therapist (OT). The final piece of this ergonomic puzzle is the proposed OT Ergonomic Protocol for children in their work environment.

Introduction to Ergonomics

There are many definitions of ergonomics. Webster's New World College Dictionary 4th Edition (2003) defines ergonomics as "*the study of the problems of people in adjusting to their environment; especially the science that seeks to adapt work or working conditions to suit the worker."* According to Dul and Weerdmeester (2001), ergonomics is an art of designing or structuring work, the work environment, or the work conditions to fit the capabilities of the worker to prevent injury and promote worker health, safety, productivity, and comfort. In order to design or structure the work, work environment and work conditions, the principles of ergonomics applies elements from many academic areas including; anatomy, physiology, psychology, and design to ensure that the products and environments are comfortable, safe, and efficient for people to use (Dul & Weerdmeester, 2001). Ergonomics takes into account the variability of size and shape among people when designing products to prevent injuries and promote employee's health, safety, and comfort.

Currently, there are three domains of specialization where ergonomics can be found; physical, cognitive, and organizational (International Ergonomics Association, 2005).

Physical Ergonomic Domain. The first domain is physical ergonomics, which is concerned with human anatomy, anthropometry, physiological and biomechanical characteristics as they relate to physical activity (International Ergonomics Association, 2005). The areas covered through this domain include work postures, handling materials, repetitive movements, work related musculoskeletal disorders, workplace layout, safety, and health. This domain is typically implemented in hospitals, skilled nursing facilities, and large healthcare systems and used to educate professionals on proper patient handling, lifting techniques, and correct body mechanics.

Cognitive Ergonomic Domain. Cognitive ergonomics is the second domain. This domain takes into consideration the human mental processes, such as perception, memory, reasoning, and motor responses, and how they affect the interactions between humans and other elements of a system (International Ergonomics Association, 2005). The areas covered by this domain include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as they relate to the human-system design. This domain is often used in office-based settings to evaluate employees and provide the proper recommendations and interventions.

Organizational Ergonomic Domain. The third domain is organizational ergonomics. This area is concerned about optimizing the organizational structures, policies, and processes (International Ergonomics Association, 2005). The areas covered by this domain include communication, crew resource management, work design, design of working times, teamwork, community ergonomics, cooperative work, virtual organizations, and quality management.

Aspects from one, two, or all three of these domains can be applied to meet the needs of the worker. Once the needs are determined and the appropriate intervention can be identified and applied, benefits are apparent in both the short and long term for both the worker and the organization.

Ergonomic Benefits

Since ergonomics has the ability to be applied in a variety of settings, many people have the opportunity to take advantage of the benefits of an ergonomics program. Employees and employers who take a proactive approach and implement an ergonomics program are able to improve the safety and health of their employees, prevent injuries and increase productivity which in turn will decrease the amount of worker's compensation costs (American Occupational Therapy Association [AOTA], 2004). There are many benefits with each and it is dependent on what you think is important. The benefits of an ergonomics program can include:

1. *Safety.* Sound ergonomic practices protect the individual from accidents and injuries (American Occupational Therapy Association [AOTA], 1999-2000).
    a. An ergonomics program can be used to educate and train employees on injury prevention, workplace health and safety regulations, and managing job-related stress.
    b. An ergonomics program can help identify, minimize and/or eliminate accident and injury risk factors associated with the employee's job tasks as well as the design and modification of the tools or equipment used.

c. Ergonomic programs can also design and implement placement screening tests to determine if potential employees are suitable for the job and the tasks associated with the position, while adhering to the requirements of the American's with Disabilities Act (ADA).

2. *Quality*. Improving the quality of the worker, the work environment and work conditions improves precision, reduces the risk of mistakes and increases productivity. The result is to accomplish more with less effort, and improve efficiency (AOTA, 1999-2000).

    a. In addition to preventing injury, an ergonomic program can also be beneficial to injured workers whose physical or behavioral limitations are preventing them from returning to full duty at their jobs. Transitional work programs or onsite rehabilitation programs can be designed for employees to benefit from when they are unable to return to their original position initially.

    b. It can be used to identify, modify, or eliminate variables in the work environment to work toward a successful, injury-free return to work.

    c. An ergonomics program can be used to modify and adapt products and systems to be more efficient, easier, and comfortable to use, resulting in increased productivity.

    d. Ergonomic services also benefit employees with disabling conditions who may qualify under the Americans with Disabilities Act, for reasonable job accommodations in their workplace environment.

3. Operational Benefits.

a. Ergonomic services can increase employee's morale and job satisfaction decreasing the turnover rates and absent employees.
b. An ergonomics program will reduce medical and insurance costs by decreasing the amount of on-the-job injuries and the amount of downtime costs for the company that is associated with employee's injuries.
c. In addition, an ergonomics program will decrease the costs associated with recruiting and training new employees due to a high turnover rate.

These are the resultant benefits of investing the resources and money into the development of an ergonomics program. In the next section, risk factors, injuries, and disorders will be identified that occur in a poorly designed work/task situation.

Risk Factors, Injuries, and Disorders

> The fact that people, of all ages, are able to use poorly designed equipment, often under difficult working conditions, shows that people are adaptable. They can tolerate small departures from optimal designs of the equipment they use and the environments in which they work. However, there is a limit to the amount of adaptation a person may reasonably be asked to make. Beyond this there is a cost. The cost can be in terms of efficiency in doing a job, discomfort, frustration, and dissatisfaction on the part of the user, and the potential for accidents and personal injury (New Zealand Ergonomic Society, 2004).

Risk factors are defined as an attribute, experience, or exposure that increases the probability of a disease or disorder though it is not necessarily a casual factor (Matoushek, 2002). The identification of risk factors has been supported by significant and numerous studies in relation to adults. These risk factors include but are not limited to (Dahl, 2000**)**:

1. Physical or biomechanical stress induced by excessive movement such as prolonged typing/keyboarding as seen by both the child and adult.

2. Sustained positions such as standing or holding a body part away from the body for long periods, which can be seen by sitting at a poorly designed workstation or computer desk.
3. Awkward or unsupported postures such as working with the back bent forward, kneeling, or stooping.
4. Excessive vibration from powered hand tools, vehicles, or other equipment.
5. Exertions associated with force caused by frequent or heavy lifting, pushing, grasping, pulling, or carrying heavy or cumbersome objects.
6. Compression or contact stress caused by resting against the edge of a work surface or grasping sharp edges like hand tools.
7. Physiological stress induced by heat, cold, use of personal protective equipment, shift work, extended work schedules, or excessive physical activity without adequate work breaks.
8. Repetition of doing a job and/or task or using the same tool over and over again.
9. Work organization factors refers to the way work processes are structured and managed.

When present for sufficient duration, frequency, or magnitude, these risk factors may contribute to work-related musculoskeletal disorders (WMSDs), cumulative trauma disorders, or computer vision syndrome. In addition, personal risk factors, such as, physical conditioning, existing health problems, gender, age, work technique, hobbies and organizational factors (e.g. job autonomy, quotas, deadlines) also contribute to the development of WMSDs, cumulative trauma disorders, and computer vision syndrome in

higher medical and time loss payments. In addition, there can be higher hidden costs when workers use more sick leave or slow their work pace during the period before a claim is filed when WMSD symptoms are beginning to develop.

Symptoms of WMSD's, cumulative trauma disorders or other related disorders can include but are not limited to (Key, 1995):

1. discomfort
2. pain
3. fatigue
4. swelling
5. stiffness
6. numbness and tingling

The various injuries and disorders that both a child and adult can be susceptible to as a result of the identified ergonomic risk factors are defined as follows:

Musculoskeletal Disorders: Musculoskeletal disorders (MSDs) are injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage and spinal discs (Occupational Safety & Health Administration [OSHA], 2003). MSDs are caused by risk factors such as; force, repetition, vibration, awkward and static postures, and cold temperatures. Prolonged exposure to ergonomic risk factors, particularly in combination or at high levels, is likely to cause or contribute to MSDs or a pre-existing MSD. The longer and more often the exposure to risk factors, the longer the time needed to recover from the exposure to ergonomic risk factors.

Work-related MSDs occur when there is a mismatch between the physical requirements of the job/tasks and the physical capacity of the worker/child (OSHA,

2003). Work-related MSDs are the most prevalent, most expensive, and most preventable adult workplace injuries in the country. In fact, MSDs account for 34% of all lost-workday injuries and illnesses and more than 620,000 lost-workday MSDs are reported each year (OSHA, 2003). Despite this, MSDs are usually very easy to prevent by incorporating some basic ergonomic principles into the work environment.

Low back pain is the most common of the work-related musculoskeletal disorders and the most expensive economically (Pheasant, 1991). About 70% of all people will suffer from one or more episodes of low back pain at some time or another in their lives. There are several risk factors that make adults more prone to developing back pain. The work-related risk factors include; 1) sitting or standing continuously at work for long periods of time and 2) jobs requiring a great deal of lifting, bending, and forceful exertion. These work-related risk factors are strong predictors of experiencing low back pain. In addition to work-related risk factors, people exhibit personal risk factors that increase the prevalence of developing back pain or injuries. The personal risk factors include; 1) prior history of low back pain 2) low overall fitness levels 3) low lifting strength 4) low endurance of back muscles 5) smoking and 6) motherhood. The habitual patterns of work activity are more significant determinants of an individual's chances of suffering from back problems than personal characteristics. Back pain is mainly a consequence of what we do through our lifestyle, not our genetic make-up.

Cumulative Trauma Disorders: Cumulative trauma disorders (CTD) are injuries of the musculoskeletal and nervous systems that may be caused by repetitive tasks, forceful exertions, vibrations, mechanical compression, or sustained or awkward positions from jobs, sports, and hobbies (New Jersey Department of Health and Senior

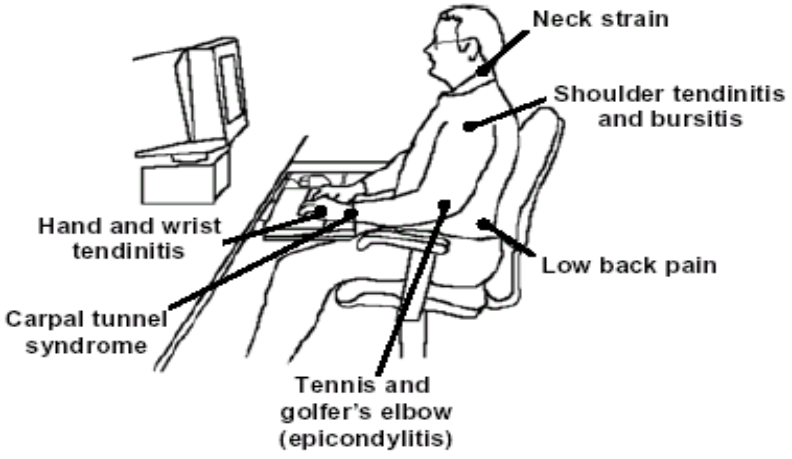
Services, Public Employees Occupational Safety and Health Program, 1997). CTDs are soft tissue disorders that usually occur in the upper body in the neck, shoulders, back, arms, wrists, and hands. Cumulative trauma disorders are also called repetitive strain injuries (RSI). These disorders develop gradually over periods of weeks, months, or years. The best treatment for CTDs is rest from the activities that caused the problem and changing daily work practices through integrating ergonomic techniques.

Posture plays a significant role in the development of CTDs and a large number of cases of cumulative trauma disorders are related to computer use (Occupational Safety & Health Administration [OSHA], n.d.). Computer users spend prolonged periods sitting at their workstations in awkward positions without repositioning themselves frequently. Slouching with the spine or leaning with the head puts the body out of balance and causes the limbs to be stretched or bent awkwardly. Too much bending or straightening in either the cervical or lumbar region takes the spine out of its neutral position and increases the risk of injury. In addition, computer users repeatedly make small movements like pressing keys or clutching and dragging a mouse. While making these movements, computer users may perform improper keying techniques that involve excessive movement of the wrists from side to side or using excessive force to key on the keyboard. Also, awkward postures used while resting over the keys or mouse, such as holding one finger up in the air or sticking the thumb out to the side, could result in the development of a CTD. Finally, CTDs could occur from positioning the keyboard or mouse too high or too far away or using a keyboard that is tilted improperly or doesn't fit the user properly.

Computer Vision Syndrome: Computer vision syndrome (CVS) affects 50%-90%

of computer users (Ergo In Demand, Inc., 2000-2004). CVS is the comprehensive term for eye and vision problems related to near work, which is experienced during or related to computer use (Anshel, 1997-2003). The constant staring at a computer screen puts tremendous amounts of stress on a person's eyes because the computer forces the visual system to focus and strain a lot more than any other task. The symptoms that most commonly occur as a result of CVS are eyestrain, headaches, blurred distance or near vision, dry or red eyes, neck and backaches, double vision, and light sensitivity. The factors that most often contribute to this condition include improper lighting, poor work habits, and existing refractive errors. Humans are visually directed creatures and they will alter their posture to alleviate stress on their eyes. Therefore, a person's posture may be indicative of a visually stressful situation. The people who are at greatest risk for developing CVS are those who spend two or more continuous hours at the computer each day. Every year, this includes a larger proportion of the workforce, and it includes most students, who now routinely use the computer for both work and play (VisionRx, 2004).

Examples of WMSD's



Although this information regarding risk factors, injuries, and disorders has historically been researched, designed, and applied to the adult workplaces, there is a growing national and international concern for the need to address the child's work environment. As Hedge (1999) asked, what happens to children? Theoretically, the research proposes that if an adult experiences injuries and disorders due to poor ergonomics in the workplace, then why would a child not be at risk as well? The first part of this process is to begin to identify what a child needs in his or her work environment.

Identifying Children's Needs in the Work Environment

A child's work environment is primarily the school environment for at least 9-10 months out of the year on an average of seven hours per day. A child's work occurs within a variety of roles such as a student or an athlete and through various work activities such as doing homework, using a computer, or playing a school sport (Jacobs et al., 2002). The United Kingdom Ergonomic Society (available on-line:http://www.ergonomimcs4schools.com. p.1) defines ergonomics as:

> Ergonomics is about 'fit': the fit between people, the things they do, the objects they use and the environments they work, travel, and play in. If good fit is achieved, the stresses on people are reduced. They are more comfortable, they can do things more quickly and easily, and they make fewer mistakes. So when we talk about 'fit', we don't just mean physical fit, we are concerned with psychological and other aspects too. This is why ergonomics is often called 'Human Factors'.

As presented prior, there are three domains of specialization for ergonomics which were identified specific for the adult. These three domains also apply to the ergonomic needs of a child. Each of these domains will be presented with definitions and examples specific to a child as follows. The purpose is to build a correlation of the

adult's patterns in work activities and relate that to the specific needs and concerns of the child in their work environment.

Physical Ergonomic Domain

Physical domain refers to the ability to use one's body with an increased purpose, skill, and control (Missouri Department of Elementary and Secondary Education, 2003). For purposes of this project, the domain focuses on the motor skills necessary to engage in a variety of physical activities as well as the development of healthy living practices.

When considering a child's physical ergonomic domain it is important to look at:

a. the child's postures
b. their developing dexterity and control to use such tools as scissors, paper punch, and stapler
c. eye hand coordination to put things together, writing, and drawing
d. using various types of technology
e. the physical layout of their work environment
f. the overall safety and health of the environment

This would include; 1) postures in and with the materials they use in their environment such as the school furniture and computer usage as well as 2) postures when carrying their backpacks. If these physical domain areas are not designed with the child in mind, they are placed at risk for musculoskeletal disorders (MSDs), cumulative trauma disorders, and/or computer vision syndrome.

Children are growing and developing at a rapid rate while they are participating in their work tasks and work environments (Lueder, 2002). A child's bones are softer than an adults because they are still experiencing growth along the growth plates, which will

define the length and shape of their future mature adult bones. Growth plates are the weakest links in children's growing skeletons and as a result most injuries occur in these areas. Damage to a child's growth plate can affect their future bone growth and some children's bones grow faster than others before their bones become stronger. Following a growth spurt, a child needs to learn new postures and coordination to accommodate their new dimensions.

School-aged children are at greater risk of manual handling injuries than adults, because they are still developing physically, which could be why children are less likely to withstand stresses that are usual to the adult spine (Harris, Straker, Pollock, & Trinidad, n.d.). Manual handling is defined as; any task which requires a person to lift, lower, push, pull, hold, or carry any object (Workplace Health, Safety and Compensation Commission of New Brunswick, 1999). Manual handling is observable in repetitive tasks such as; typing on a keyboard, writing papers and assignments, painting pictures, assembling blocks or models, and sorting items. A child's spine also evolves and differs from an adult's spine (Lueder, 2003). Children are born without a lumbar curve in their spine and this develops as children progress towards adolescence.

General Postures and Positioning. Children spend approximately thirty percent of their waking hours at school and the amount of time that they are required to spend sitting is considerable (Knight & Noyes, 1999). According to Jacobs et al. (2002), third and fourth graders are expected to remain seated for two thirds of the school day while seventy-five percent of their total body weight is supported by only four square inches of surface when sitting. Storr-Paulsen and Aagaard-Hensen (1994) noted that eight and nine year-olds were expected to sit for more than 60 minutes in any 90-minute period, while

Dunnon (1976) observed that nursery school children were seated for 37.2% of their time in the classroom (as cited in Knight & Noyes, 1999). In addition, he found that senior school students aged 13 to 16 years of age spent 78.7% of their time sitting in the classroom. As the literature indicates, the amount of time school-age children are required to remain sitting varies across age ranges but it is a considerable amount of time.

School furniture has specific functions in the classroom which are; 1) support the child when attending to the teacher and 2) support the child when writing or drawing on the work surface (Knight & Noyes, 1999). Unfortunately, the design of current school furniture doesn't facilitate these two common postures of school-aged children (Jacobs et al., 2002). Children spend most of their school days in chairs and at desks that don't adequately fit their bodies. The chairs backward-angled seat pan causes excessive bending forward, placing strain on the back and neck as well as eliminating back support. In addition, incorrect seat height and length can result in discomfort, and add pressure and extra weight to the child's thighs and legs. Another less cited function of school furniture is to ensure that school-aged children stay in one place, in order to facilitate monitoring of their behavior and to minimize distracting interactions (Knight & Noyes, 1999). Unfortunately, designers have forgotten to incorporate the most important function of school furniture, which is to facilitate learning through providing a comfortable and stress-free workstation. Hedge (1999) indicated that the research identifies that when adults work in a deviated posture there is an increased injury risk to the upper body so he asks, what happens in children?

Computer Usage, Postures, and Positioning. Computers are changing the nature of education throughout the world (Bennett, 2001). During the past three decades

computers have gone from being scarce in universities and colleges to being a standard part of the elementary schools in industrialized nations. In 1999, the average U.S. public school contained 100 computers and schools with Internet access increased from 35 percent in 1994 to 95 percent in 1999 (Bennett, 2001).

In school, students use computers mainly for Internet surfing (48%) and for academic purposes (42.3%) whereas at home children are using computers for computer games and Internet surfing (Szeto, G.P.Y., Lau, J.C.C., Siu, A.Y.K., Tang, A.M.Y., Tang, T.W.Y., & Yiu, A.O.Y., n.d.). Children are spending approximately 2.85 hours/week playing computer games and 2.77 hours/week surfing the Internet. At the present rate, children will spend more than two years on email and more than 23 years on the Internet during their lives (Hedge, 1999). According to Jacobs et al. (2002), households that have children ages 2-17 years old and own computers jumped from 48% in 1996 to 70% in 2000. As a result, many school-aged children are working and playing at computer workstations in their homes that are designed to fit the physical proportions of their parents, in addition to the poor fitting equipment present in the school environment. This may cause the child to sit in uncomfortable positions, making the opportunity for long-term injuries on school-aged children greater than ever.

The increased use of computers at both home and school has resulted in an increase in the number of injuries and discomfort related to the use of computers in the classroom. One study found that when children experience discomfort while using computers, they are more likely to continue and less likely to report the discomfort to adults, than children playing sports or musical instruments (Bennett, 2001). Also, studies have shown that children are frequently in “at risk” postures while they are using

computers but these postures aren't being maintained for long periods of time. This is likely due to school systems not being aware of ergonomics and buying school furniture that is not adjustable. The computer workstations need to be kid sizes and appropriate for the grade levels (Jacobs et al., 2002). Small keyboards and kid size mouse's are available.

Backpack Postures and Positioning. Not only do school-aged children experience the effects of poorly designed school furniture, but they also experience discomfort related to carrying their backpacks. In the U.S., it is estimated that over 40 million students carry their books and other school materials in a backpack and more than half of them may be carrying too much weight (AOTA, n.d.). The fact that textbooks are getting heavier and some schools are taking away lockers, is forcing children to carry all of their daily belongings in their backpacks (Barrero & Hedge, 2000). Children carrying overloaded and improperly worn backpacks are likely to experience neck, shoulder, and back pain resulting in adverse effects on posture and the developing spine, compromised breathing, and fatigue (AOTA, n.d.). According to a survey completed by Pascoe et al, (1997) found that schoolchildren most often carry their backpacks improperly by using only one-strap to transport their school supplies. A kinematic analysis completed in the study by Pascoe et al, (1997) showed that the one-strap bag carriage caused a right shoulder elevation and a leftward curvature of the spine away from the weight of the book bag. In addition, a study completed by a London-based National Back Pain Association (1997), found that 11 and 12 year olds were wearing backpacks that were as much as 60% of their own body weight (Barrero & Hedge, 2000). It is recommended that a child should carry a backpack that weighs up to 15% of their body weight and

never more than 20% of their body weight. Carrying backpacks improperly that weigh too much, results in approximately 23% of elementary school-aged children and about 33% of secondary school-age children complaining of backaches (Jacobs et al, 2002). The U.S. Consumer Product and Safety Commission estimated that more than 7,000 emergency room visits in 2001 resulted from injuries related to backpacks and half of these injuries occurred in children ages 5-14 years old (AOTA, n.d.). Not only can backpacks cause immediate pain, but the child can suffer from this form of an injury for the rest of their lives.

In addition to experiencing developmental stages at differing rates, children can develop musculoskeletal disorders that are associated with various risk factors such as poorly designed work environments. Children will experience physical risk factors associated with prolonged sitting, mismatched school furniture to their body size, lack of awareness of postures, and lengthy computer durations. In addition, the presence of physical risk factors influences the cognitive ergonomic domain.

Cognitive Ergonomic Domain

In a child's cognitive ergonomic domain the focus is on their human mental processes, such as; perception, memory, reasoning and motor reactions in response to cognitive demands/requests (International Ergonomics Association, 2005). This more specifically includes their mental workload, decision making, performance, human computer interaction, human reliability, work stress, and training as they relate to the human-system design.

In addition to the physical risk factors presented prior, children will also experience cognitive risk factors. The computer task, whether it is school-related or fun,

will affect the child's motivation to engage in the task (Harris, Straker, Pollock, & Trinidad, n.d.). The purpose of the computer task will often dictate the duration required for the task, the work posture, and the environment it is performed in. A child who is required to complete an assignment or engrossed in a computer game may adapt to an awkward position for prolonged periods of time to complete the task. They are able to ignore the symptoms and may not be aware of minimizing injuries by taking breaks and resting. Because of this, children are more likely to exhibit a wide array of emotions such as irritability due to prolonged sitting. School-aged children can also experience psychosocial factors and studies have shown that these factors related to home and work environments play a role in the development of musculoskeletal disorders. These psychosocial factors include student's behavior and the attitudes of educationalists and parents. In addition, these factors may influence student's satisfaction and productivity in their learning environments.

Because children experience various developmental stages, it is a crucial time to teach them good work habits that can set them up for a lifetime of safe practices (Lueder, 2003). As children grow and develop, they learn how to deal with new environments that will affect the risks they face as they develop, mature, and age. It is best to teach children how to do it right the first time instead of having to relearn safe practices later in life.

Organizational Ergonomic Domain

The organizational domain of a school system refers to the resources and structures of the system in which teaching and learning occur (Mid-continent Research for Education and Learning [McREL], 2003). Improvement efforts that relate most closely to this domain include finding ways to involve stakeholders in school

improvement efforts, encouraging teachers to integrate technology into instruction, and evaluating emerging government regulations or changes in the public's view of education (e.g., parents concerns about the quality). Organizational domain can include aspects such as; external environment (community), stakeholders (parents, teachers, family), resource allocation (money, schedules, time, technology), technology (hardware, software), and accountability (responsibility for student achievement).

During the past two decades, the influences of technology have been superimposed upon the traditional structure of education (Bennett & Tien, n.d.). As schools in many parts of the world integrate technology into the learning environment, classrooms have changed in a fundamental way. Children are now using computers throughout their entire education. As schools have focused on purchasing computers and providing Internet access, there has been little consideration of ergonomics. Technology is typically brought into physical environments that haven't changed to accommodate them. Computers are placed on tables and desks that are a legacy from the past. Ergonomics has rarely been incorporated into the design of school furnishings and children sit on chairs designed by tradition. The size and shape of computers, keyboards, and pointing devices aren't usually tailored to children.

Not only are children using ergonomically incorrect technology and furniture, but teachers aren't applying ergonomic principles to the classroom. The vast majority of schools aren't teaching ergonomics to the students or teachers (Bennett, 2001). The importance of teaching ergonomics may not have occurred to administration or teachers because it is left up to the individual schools and districts to educate staff and students on the benefits of implementing ergonomics (Croasmun, 2003). Information needs to be

available to school administrators, teachers, parents, and students so that everyone can practice ergonomic principles at school and home!

Adult-Child Risk Factor Comparison

Putting the Pieces Together

Many of the risk factors affecting the adult workforce are similar to the risk factors affecting children. As stated prior, the presence of risk factors increases the opportunity of injury whether short term or long term. As the number of factors increases or the duration for which the child or adult is experiencing the risk increases, the damage also increases.

As presented prior, adults in the workforce are at risk of experiencing injuries and disorders, such as musculoskeletal disorders, cumulative trauma disorders, or computer vision syndrome as a result of their jobs and poor ergonomics so theoretically it is proposed that the same risk of injury would be present for the child.

In Table 1 on the next page, there is a summary of factors that affect both the child and adult. The research supports the identification of these factors as risks for the development of injuries and disorders for the adult. If these are risk factors for the adult, they would theoretically be risk factors for the child as well. The information in the table presents the risk factor with a definition provided, which is followed by an example or examples of how these are seen when doing a job task. The third column presents the outcome or impact if the risk factors are not minimized or eliminated. These are outcomes for the physical body in general and it is important to stress that the risk factors do not distinguish the age of the body.

Table 1 Summary of Factors Affecting Adults and Children

Risk Factor	Example	Outcome/Impact
Physical or biomechanical stress	• holding the hands in place above the keyboard or mouse • looking down at documents lying flat on the desk • holding down the shift key • sitting upright without back support • keeping the head still while reading from the monitor • holding the handset while talking on the telephone • holding boxes in the hands while carrying them long distances •sitting for prolonged periods of time	•has an effect on 'on task' behavior in class and at work •pain and discomfort have an impact on the ability to focus on learning; decreased educational attainment • failure to achieve productivity goals •increase in psychosocial problems •increase in MSD's •spine is undergoing sporadic and extreme growth. Research indicates carrying book bags of 17% body weight alters posture and gain, has detrimental affects on lung volume and may lead to a variety of MSD complaints (Bennet, 2002) • increased risk of neck and upper limb MSDs •increased risk of low back pain •decreased whole body activity •repetitive arm motions when using the mouse are much more likely to result in shoulder injury if the mouse is beyond the keyboard, forcing the worker to elevate their arm and work in an awkward posture. Also, repetitive keyboard use has been shown to be more likely to result in a WMSD when more force than necessary is used on the keys. •fatigue, swelling, muscle strains and ligament strains. •increased reports of visual discomfort •increase in myopia
Sustained Positions	•sitting at a poorly designed workstation or computer desk	
Awkward or unsupported postures that bend the joints into positions where they are more likely to become injured.	• typing with bent wrists • slouching or leaning forward in the chair • turning the head to the side to view the monitor • cradling the phone between the ear and the shoulder • reaching up and over the keyboard to use the mouse • elevating the arms when writing on a work surface that is too high • leaning over to type in data from papers laying flat on the desktop • bending at the waist to load copy machines	
Exertions & Force: Many office tasks require a moderate amount of force to be applied by very small muscles, which may cause	• carrying or frequent lifting of heavy or cumbersome objects • lifting heavy objects with one hand (manuals, books, backpacks)	
Compression or contact stress •manual handling	• resting wrists on the edge of the desk while typing or using the mouse • using rubber stamps with handles that press into the palm of the hand • leaning the elbows on hard chair armrests or work surfaces • using scissors with hard, metal handles • typing with palms resting on the hard lip of a keyboard tray • sitting in a chair that places pressure on the back of the thighs	
Repetition: Performing the same or similar motions repeatedly can result in trauma to the joints and surrounding tissues. Without time for rest and recovery, repetition can lead to injury.	• typing at the keyboard • flipping through files and paperwork • moving and clicking the mouse • using a calculator • looking back and forth between the monitor and source documents • writing by hand	
Vision is usually the primary channel for information	• poorly designed systems so that the user is unable to see the work area clearly • cannot see the screen because of glare or reflections • eyestrain	

Benefits of Ergonomics for Children

The benefits of ergonomics for adults are the same for children, just in different aspects. School personnel who take a proactive approach and implement an ergonomic program are able to improve the safety and health of their employees and children as well as prevent injuries and increase productivity (Jacobs et al., 2002). There are many benefits with each dependent on what you think is important. The benefits of an ergonomic program can include (Dahl, 2000):

1. *Safety*. Sound ergonomic practices protect the individual from accidents and injuries.
    a. An ergonomics program can be used to educate and train employees, children, parents, and the community on injury prevention, workplace health and safety regulations, and managing task-related stress
    b. An ergonomics program can help identify, minimize, and/or eliminate accident and injury risk factors associated with the child's job tasks, as well as the design and modification of the tools or equipment used
    c. Lower risk of injury rates as the child develops
    d. Greater user comfort
    e. Easier maintenance
2. *Quality*. Improving the quality of the child, the work environment, and work conditions improves precision, reduces the risk of mistakes, and increases productivity. The result is to accomplish more with less effort, and improve efficiency.

a. Products that are easier to use to complete the task(s) quicker with greater efficiency: faster learning times, fewer errors
b. A general increase in task satisfaction results in increased motivation, school satisfaction, self esteem, and confidence

3. *Improved Physical Ergonomic Domain*.
    a. Posture improves allowing for the development and refinement of fine motor skills such as dexterity and control necessary for the use of tools such as; scissors, paper, and keyboard
    b. Eye hand coordination improves for use in job tasks such as writing and drawing
    c. Visual skills optimized
4. *Improved Cognitive Ergonomic Domain*. A child's cognitive skills are influenced by feeling comfortable physically. When the physical domain is addressed appropriately, the cognitive domain can function much more effectively and efficiently.
    a. Memory
    b. Stress
    c. Decision making
    d. Work output
    e. Attitude
5. *Improved Organizational Ergonomic Domain*.
    a. Improved quality of student's work/achievement
    b. Improved utilization of resources, money, and technology

c. Improved collaboration of school system, personnel, parents, children, and community

Role of OT

Occupational Therapy views humans holistically and has adhered to a holistic approach (Sabonis-Chaffee & Hussey, 1998) which means as the individual is considered, everything else they are working with or doing must also be considered. An individual is not isolated from their environment(s), so it is important to assess how the individual is doing physically, cognitively, and organizationally with their job tasks in their environment(s). If any element or subsystem is negatively affected, a disruption or disturbance will be reflected throughout the whole. A basic understanding of this approach will ensure that an OT examines all areas of a child's life to determine what needs have to be improved by incorporating ergonomic principles into their daily lives. Dahl (2000, p. 43) identified the following OT knowledge and skills that relate to ergonomics:

1. Evaluation and intervention skills to work with different populations with a wide range of abilities, ages, and cultures in home, school, and work environments
2. Identification of user characteristics through evaluations of physical, functional, perceptual-cognitive, and psychosocial abilities
3. Knowledge of human performance models and activity analysis skills
4. Knowledge of work-related injuries, diseases, and injury prevention methods
5. Basic engineering knowledge to apply to evaluations for the fabrication of orthotics, modified tools, and adaptive devices and equipment

6. Basic environmental design skills in adapting and modifying layouts and furniture to improve accessibility, work flow, safety, and productivity
7. Experience working on multidisciplinary teams

Task analysis defines the relationship between the person and the environment as an action oriented toward an object (Neistadt & Blesedell Crepeau, 1998). As a theoretical approach, task analysis has been highly developed in ergonomics. An ergonomics approach to capability-demand models uses task analysis to divide tasks into discrete sequential steps, and then defines the physiological, sensory, and cognitive requirements for successful task completion. The OT then makes a comparison of the demands of each step of the task, including environmental demands, with the capabilities of the person. When the task-environmental demands are greater than the person's capabilities, the specific area for intervention is targeted.

An OT's educational training is heavily focused on the developmental stages and needs of the individual, as well as their interaction within their environment(s) such as home, work, and play. Occupational Therapists receive both undergraduate and graduate training on the physical, psychological, and cognitive developmental stages of an individual from birth to senescence. OT training focuses on how to adapt or modify the individual and/or their environment in order to maximize their success and safety. In addition, OT's have a wide knowledge background similar to the principles of ergonomics. As occupational therapy students, our education is holistic. OT's receive in-depth training and understanding in a variety of areas including pediatrics, anatomy, muscle function, psychosocial aspects of children, and assistive technology. As a result of OT's holistic education, OT's are able to assess the situation, break down the

problematic task(s) through task analysis, and then provide the appropriate interventions by adapting or modifying the task. Based on educational preparation, OT's are well suited to educate a child, their parents, and their teachers on the importance of incorporating ergonomic principles in the classroom. As we all know, learning good posture and work habits requires the same effort as learning poor posture and work habits!

Based on the educational preparation an OT has, it is appropriate for occupational therapists to be an advocate and active participant in the process of applying ergonomic principles and programs for children. Occupational Therapists are already established as a necessary team member in the school systems. OT's in the school systems provide services to children with disabilities to maximize their learning opportunities and potential through various means such as classroom adaptation and modification. The training, skills, abilities, and presence of an OT in the school system provides an excellent opportunity for the development and implementation of an ergonomics program. Based on these factors, the only part missing from this OT student's perspective was the design of a more comprehensive foundational protocol.

Introduction to OT Protocol

The literature has supported a significant need for an ergonomic program to be designed and implemented in the school systems. In addition, the educational preparation of an OT provides support that the foundational skills and knowledge are present to enable an OT to be a qualified provider of an ergonomic program.

Based upon the review of literature a protocol for OT's to implement has been designed. This protocol is divided into the following sections; Assessment,

Implementation, Education, and Protocol Evaluation. A brief introduction to each of these sections is as follows;

1. *Assessment Section.* This section of the protocol contains information and resources that will assist an occupational therapist to assess ergonomics with school-age children. In this section, there is a comprehensive four-section assessment checklist that will assist the OT when evaluating the child's posture, the workstation environmental features, the child, and backpacks. Through this checklist, the OT will be able to determine if there is or isn't acceptable ergonomic design conditions present and then address the source of poor ergonomics that are affecting the child.
2. *Implementation Section.* This section of the protocol contains information and resources to assist an occupational therapist with the implementation of ergonomic strategies and techniques with school-age children. The implementation section follows the same format as the assessment checklist, so the OT can refer to this section once poor ergonomics have been identified. The strategies and techniques aren't comprehensive, so through continued research and practice, the OT will find additional rationale to support the interventions.
3. *Education Section.* This section of the protocol contains information and resources that will assist an occupational therapist in educating other healthcare professionals, school personnel, parents, and children on the benefits of ergonomics. This section contains a sample workshop outline, and educational handouts on backpack safety, school furniture/workspace design,

and computer use. Hopefully through education, it will guarantee a change in poor ergonomics with follow through at home and school to correct their poor habits.

4. *Protocol Evaluation Section.* This section of the protocol contains a sample survey that an OT can use as a guide to measure the success of the tools they implemented. The survey is designed to assess the usefulness of the protocol information and parent and/or teacher satisfaction of the implementation of the protocol based on student's complaints, concerns, or comments. The survey is designed to initiate the process of gathering evidence based outcomes.

Summary

The literature review has provided the reader with an introduction to ergonomics and how it impacts an adult's work environment. In addition, the literature review educated the reader on a child's work environment and the lack of ergonomics in their environments. The goal of the literature review was to correlate the commonalities of the adult work environment and the child's work environment in building support for the need to address ergonomics in the school system.

Based on the child's needs within their environment, an occupational therapy protocol has been proposed to assist the OT with the evaluation, and implementation of an ergonomics program through direct intervention and educational approaches focusing on the school educators, parents, and students on the importance of implementing ergonomics into a child's work environment. The information presented in this literature review supports the need for the proposed protocol. The profession of OT needs to take a

proactive, preventive approach to educate and communicate to others the need for implementing ergonomic principles at a young age (Jacobs et al., 2002).

It is hoped that through this literature review, the reader has gained a better understanding of ergonomics and the benefits of implementing the principles at an early age with children. It is imperative that the children's health be protected for their own sake as well as for the stability of the future socioeconomic environment (Bennett & Tien, n.d.). After all, these children are in school today to learn how to tackle the workforce tomorrow (Croasmun, 2003).

CHAPTER THREE

ACTIVITIES/METHODOLOGY

Through participation and learning in the OT curriculum and extracurricular activities, an interest in ergonomics developed. During the spring semester of the 1st year of the OT program, this OT student had an opportunity to participate in a Pi Theta Epsilon community outservice. This outservice experience occurred at an East Grand Forks elementary school and focused on promoting backpack awareness with 4th-6th graders. The Pi Theta Epsilon members educated the students and their teachers on how to wear their backpacks correctly and how much their backpacks should weigh. The Pi Theta Epsilon members weighed each student's backpack and then adjusted the student's backpacks to fit them correctly. This was the first time that this OT student became aware that ergonomics could be used with populations other than adults in the workplace.

On a Level I Physical Disability clinical practicum, this OT student was able to observe an occupational therapist evaluate several employees' workstations. Based on the evaluation, the OT recommended appropriate ergonomically correct strategies and equipment to correct poor ergonomics with adults in various job settings. As a result of this experience, this OT student realized how beneficial ergonomics are for adults and questioned why the same ergonomic strategies aren't being implemented at a younger age to prevent incidents from occurring later in life.

Following this thought, this OT student felt a need to research and learn more about ergonomics to determine what information was available regarding school-age children and ergonomics. Through this process, it was quickly realized that there wasn't a lot of current occupational therapy literature focusing on ergonomics and school-aged children. Due to the limited research available on this topic, it was this OT student's decision to pursue this as a scholarly project.

A comprehensive review of the literature was conducted to determine if there were any correlations among the commonalities of the adult work environment and the child's work environment. This was necessary in order to support the need for addressing ergonomics in the school system. Due to the limited amount of occupational therapy literature, it was necessary to research outside of the professional OT literature. Several ergonomic web sites were evaluated to determine key points that needed to be addressed through an OT protocol focusing on a child's work environment. The literature review provided a good knowledge base that would assist in the development of the OT protocol.

The OT protocol is based on the literature review findings and it incorporates guidelines and strategies that were located through research. Ergonomics and implementing strategies with adults is not a new concept, therefore pieces of information pertinent to adults was able to be developed into a modified version for children. The primary information used for the development of the scholarly project was solicited from ergonomic web sites that focused on children. This was not due to trying but at this point in time, this is where the majority of the published research is available.

The OT profession could grow in this area and significantly benefit school-aged children. By implementing ergonomic strategies at a young age, children will be able to develop life-long strategies that will prevent injuries and/or disorders in the future. By doing this, it could decrease the prevalence of work-related injuries in their futures. This OT student has enjoyed writing this protocol and anticipates utilizing it in the future as an OT professional.

CHAPTER FOUR

PRODUCTS/RESULTS

Based on the literature review findings, an OT protocol has been developed to be implemented by OT's in the school system. OT's have received the educational background that supports the foundational skills and knowledge needed to be a qualified provider of an ergonomics program. This protocol will be used to inform and educate other healthcare professionals, school personnel, parents, and children on the benefits of an ergonomics program.

The protocol is divided into 4 sections; Assessment, Implementation, Education, and Protocol Evaluation. A brief introduction to these sections is provided in the following;

1. *Assessment Section.* This section of the protocol contains information and resources that will assist an occupational therapist to assess ergonomics with school-age children. In this section, there is a comprehensive four-section assessment checklist that will assist the OT when evaluating the child's posture, the workstation environmental features, the child, and backpacks. Through this checklist, the OT will be able to determine if there is or isn't acceptable ergonomic design conditions present and then address the source of poor ergonomics that are affecting the child.

2. *Implementation Section.* This section of the protocol contains information and resources to assist an occupational therapist with the implementation of ergonomic strategies and techniques with school-age children. The implementation section follows the same format as the assessment checklist, so the OT can refer to this section once poor ergonomics have been identified. The strategies and techniques aren't comprehensive, so through continued research and practice, the OT will find additional rationale to support the interventions.
3. *Education Section.* This section of the protocol contains information and resources that will assist an occupational therapist in educating other healthcare professionals, school personnel, parents, and children on the benefits of ergonomics. This section contains a sample workshop outline, and educational handouts on backpack safety, school furniture/workspace design, and computer use. Hopefully through education, it will guarantee a change in poor ergonomics with follow through at home and school to correct their poor habits.
4. *Protocol Evaluation Section.* This section of the protocol contains a sample survey that an OT can use as a guide to measure the success of the tools they implemented. The survey is designed to assess the usefulness of the protocol information and parent and/or teacher satisfaction of the implementation of the protocol based on student's complaints, concerns, or comments. The survey is designed to initiate the process of gathering evidence based outcomes.

The Ecological Model of Occupation was used as a guide when developing this OT protocol. This model considers the relationships among person, task, and context and how the dynamic interactions between these three impact performance. In addition, this model emphasizes the essential role of context in task performance, and intervention is directed by what the person wants and/or needs. This model is appropriate for this OT protocol, because it addresses the importance of modifying the child's environment and contexts to increase their learning experiences.

Assessment Section

This section of the protocol contains information that will assist an occupational therapist to assess ergonomics with school-age children. All of the information in this section is specific to assessment only. In addition, this section provides the OT with resources that will assist and guide them in assessing the child and their workstation.

This section contains a comprehensive four-section assessment checklist that will assist OT's when evaluating the child's environment and how it affects the child. The assessment checklist primarily focuses on the child's posture, the workstation environmental features, the child, and backpacks.

Section I

This section of the assessment checklist focuses on a child's posture by addressing the child's upper and lower extremities, and their force static body posture. This section looks at how a student's posture is affected by their workstation setup.

Section II

This section of the checklist concentrates on the child's workstation and the environmental features associated with their workstation. This section examines the child's work surface; the chair seat surface and backrest; the computer monitor, keyboard, and mouse; document holder; hand, arm, and foot support; and lighting, temperature, vibration, noise, and ventilation.

Section III

This section of the assessment checklist focuses on the child. Through this section, the OT is able to determine if the child is experiencing fatigue, visual problems, or psychosocial issues as a result of using a computer.

Section IV

This section of the checklist addresses the child's backpack to ensure that the child isn't wearing their backpack incorrectly. In addition, the checklist examines the student's backpack to ensure that the child's backpack has padded straps and a waist belt. It also has the OT determine if the child's backpack weighs more than 15% of their body weight.

While completing the assessment checklist, the OT will check either "yes" or "no" for each question. A "yes" response will indicate that there are acceptable ergonomic design conditions present and a "no" response indicates that the condition may be associated with a high risk of illness or injury and correct interventions should be implemented to address the source of the problem. Intervention ideas, resources, and suggestions are located in the implementation section of the protocol. Through this checklist, an OT can determine and address the source of poor ergonomics that are affecting the child.

Assessment Checklist

Posture

Lower Extremities:	**Yes**	**No**
Is the student able to rest their feet comfortably on the floor?		
Is the student able to sit with their knees at a comfortable position (approximately at a 90 degree angle)?		
Is the student free of uncomfortable pressure points, obstructions, or any other objects that interfere with their lower extremities?		

Upper Extremities:

Is the student able to work with their head in an upright neutral position, which doesn't strain their neck and shoulders?		
Is the student able to work with their head slightly forward or in midline majority of the time, minimizing long durations of head rotation?		
Is the student able to reach objects on the workstation without excessive upper body extension for long periods of time that is repetitive, or requires trunk/torso deviation?		
Is the student able to work in a neutral shoulder position (arms close to their body and relaxed; not abducted out to the side, extended forwards or backwards, raised up, or hunched)?		
Are the student's elbows in a comfortable position (elbows close to their body; not abducted out to the side, raised up)?		
Are the student's wrists in a neutral position (hands in a straight line with their forearms; hands not flexed down towards the palm, extended up towards the ceiling, ulnarly deviated towards their little finger, or radially deviated towards their thumb)?		

Force Static Body Posture

Does the student's workstation design cause them to maintain non-neutral body positions for extended periods of time (30-60 minutes)?		

Workstation and Environmental Features

Chair Seat Surface	Yes	No
Is the student's chair seat surface height adjustable, so that they are able to sit at a comfortable height that is in relation to their required tasks?		
Is the student's chair seat the appropriate size for their body (deep and wide enough to comfortably accommodate them)?		
Is the student's chair seat comfortable for them (don't experience pressure on the under side of their leg)?		

Chair Seat Backrest		
Can the student adjust the seat height to provide adequate lumbar support?		
Can the student adjust the seat's backrest angle relative to the seat height?		
Can the student adjust the seat backrest to alter the seat depth?		
Is the backrest comfortable for the student?		

Work Surface		
Is the student's workstation width appropriate (all required task accessories and duties are located within comfortable reach and viewing distance)?		
Is the student's workstation depth appropriate (computer and keyboard placed directly in front of the student)?		
Is the area under the workstation tall and wide enough to accommodate the student's legs, and any other accessories (footrests, armrests)?		

Computer Monitor		
Is the student able to adjust the monitor height easily?		
Is the student able to easily adjust the monitor tilt (up/down) angle?		
Is the student able to adjust the monitor's left/right rotational angle?		

Keyboard	**Yes**	**No**
Is the keyboard detachable from the computer monitor?		
Is the student able to easily adjust the keyboard height?		
Is the keystroke pressure comfortable for the student?		
Has the student correctly adjusted the keyboard angle so that their hands/wrists are in neutral position when they are typing?		

Mouse

Is the shape of the mouse and button activation comfortable and easy to use for the student?		
Is the student able to reach and operate the mouse without long durations of time, or repetitive reaching with their shoulders, arms, and wrists in neutral position?		
Is the mouse in a position that can be used within the person's immediate reach zone?		

Document Holder for Data Entry Tasks

Does the student have a special holder or support for their documents?		
Is the student able to easily adjust the document holder height, distance, and angle?		
Is the device located in a position that doesn't require the student to twist their head/neck back and forth between the document and screen for long periods of time?		

Hands and Arm Support

Does the student have padded armrests on their chair or are other padded armrests available?		
Are the armrests adjustable (height, lateral positions)?		
Is a broad, flat keyboard palm support available to support the student's hands in neutral position between bursts of typing movements (not a wrist rest because they can put extra pressure on the carpal tunnel)?		
Is the palm supported for mouse use?		

Foot Support	**Yes**	**No**
Are the student's feet flat on the floor when they are sitting at their workstation?		
Is a footrest available if needed?		
Can the student easily adjust the footrest height and tilt?		

Lighting

Are lighting levels appropriate and comfortable for the student when using their computer?		
Is the monitor screen placed appropriately to prevent glare from the windows or overhead lights?		
Are movable tasks or lights available for the student?		
Do windows have curtains, drapes, or blinds to block light where glare from the source is a problem?		
Does the student's work surface have a dull finish to reduce light reflection?		

Temperature

Is the student comfortable with the room temperatures?		
Is the student comfortable with the temperatures of the equipment or surfaces that they contact?		

Vibration

Does the student experience any uncomfortable keyboard vibrations?		

Noise

Are sound levels at a comfortable level, easily allowing for conversation and communication with peers or attention to their task?		

Ventilation	**Yes**	**No**
Is the air circulation sufficient for the student?		
Is the air quality satisfactory?		
Is the air too dry or too humid?		

THE STUDENT

Fatigue Control	**Yes**	**No**
Is the student allowed to take rest breaks from tasks that require long duration (30-60 minutes), repetitive postures, or excessive keying or mousing activities?		

Vision

Is the student experiencing eyestrain, burning sensation, blurred vision, or headaches?		
If the student is experiencing these issues have they had a recent eye exam/screening?		

Psychosocial Issues

Is the computer software "user friendly" for the student?		

Adapted from Cornell University Ergonomics Web (2005)

Backpack

Backpack Features	Yes	No
Does the student's backpack have wide, padded straps?		
Does the student's backpack have a waist belt?		
Does the student's backpack have good padding on the area that rests against their back?		

Correct Use of Backpack

Is the student's backpack worn on both of their shoulders?		
Is the student wearing their backpack high on their shoulders (bottom shouldn't rest more than 4 inches below student's waistline and shouldn't be higher than the student's upper shoulder blades)?		
Does the student's backpack fit snuggly against their back?		
Is the student using the waist belt?		

Backpack Weight

Does the student's backpack weigh more than 15% of their body weight?		

Resources

Books

Lancy, M. (1999). *Children and safe computing keeping your child RSI-free*.

Lueder, R. & Rice, V. (Eds.). (in press). *Ergonomics for children*.

Visual Material

Don't let a computer hurt your kids what every parent should know! (2000). Wilmington, Del: Emerald Communications.

Journals

Bennett, C.L. (2001). Classrooms and computers: An elementary school case study. *Advances in Occupational Ergonomics and Safety, 4*, 354-360.

Jacobs, K., Bhasin, G., Bustamante, L., Buxton, J.C., Chiang, H.A., Greene, D., Ford, S., Frank, R., Moczydlowski, E., Naidu, J., Nielsen, E., Savini, A., Singer, B., & Wieck, A. (2002, May 27). Everything you should know about ergonomics and youths, but were afraid to ask. *OT Practice*, 11-19.

Web sites

Workstation Ergonomic Guidelines for Computer Use by Children

1) http://www.ergoworksconsulting.com/Articles/ChildrenErgonomics.html
2) http://ergo.human.cornell.edu/cuweguideline.htm
3) http://ergo.human.cornell.edu./MBergo/schoolguide.html
4) http://www.education.umn.edu/kls/ecee/guidelines.html

Backpack Ergonomic Guidelines for Children

1) http://ergo.human.cornell.edu./MBergo/schoolguide.html
2) http://www.aota.org
3) http://www.newton.mec.edu/day/backpack.html

Children and Vision

1) http://www.aoa.org
2) http://www.nei.nih.gov
3) http://www.opticalinternet.com

Child Injury Prevention

1) http://humanics-es.com/recc-child.htm
2) http://www.cdc.gov
3) http://www.cpsc.gov
4) http://consumerreports.com
5) http://cpsc.gov/neiss

Implementation Section

This section of the protocol contains information to assist an occupational therapist with the implementation of ergonomic strategies and techniques with school-age children. The implementation section follows the same format as the assessment checklist, so once the OT has identified an area that needs to be corrected, they can refer to this section.

The implementation section provides the OT with strategies, rationale, and suggestions to correct poor ergonomics that were identified in the assessment section with a "no" response. Strategies and rationales have been provided to ensure that the appropriate measures to correct poor ergonomics have been implemented.

The implementation section focuses on the child's posture, the workstation environmental features, the child, and backpacks. These strategies are not comprehensive so through continued research and practice, the OT will find additional rationale to support the interventions. In addition, this section contains a resource list that the OT can use in the implementation process.

Lower Extremities

Is the student able to rest their feet comfortably on the floor?

Reasoning: If the student is able to rest their feet comfortably on the floor, this will reduce the pressure on the back of their thighs and also puts the student's body in proper alignment.

Intervention Strategies:

1) Purchase a footrest
2) Place books, binders, or a box under the student's feet to provide them with a stable surface to rest their feet on
3) Move the computer to a lower surface so the student won't have to sit on as high of a chair which prevents their feet from touching the floor

Is the student able to sit with their knees at a comfortable position (approximately at a 90 degree angle)?

Reasoning: If the student's knees are higher than their hips, it places increased stress on the tissues and muscles in their back.

Intervention:

1) Adjust the seat height so they are seated at a 90 degree angle
2) Place a firm cushion/pillow underneath the child if the seat isn't adjustable
3) If the seat isn't adjustable, ensure that the student's feet are touching a stable surface by placing books, binders, or a box under their feet

Is the student free of uncomfortable pressure points, obstructions, or any other objects that interfere with their lower extremities?

Reasoning: If objects are interfering or obstructing the student's lower extremities, they may maintain non-neutral positions for long periods of time that are uncomfortable and cause stress, pain, and fatigue on their body.

Interventions:

1) Remove or reposition objects located underneath the student's workstation so they don't interfere with the student's lower extremities

Upper Extremities

Is the student able to work with their head in an upright position?

Reasoning: This will prevent the child from experiencing strain in their neck and shoulders.

Intervention:

1) Adjust the computer monitor height and angle. For specifics, please see page 80 of the Educational section.
2) Adjust the student's chair height. For specifics, please see page 80 of the Educational section.

Is the student able to work with their head slightly forward or in midline majority of the time, minimizing long durations of head rotation?

Reasoning: This will prevent the student from having to maintain awkward neck positions and as a result experiencing neck strain and pain.

Intervention:

1) Place the computer monitor directly in front of the student about an arm length away
2) Place the computer directly facing the student, so that it isn't angled left or right
3) Provide the student with frequent rest breaks during the day
4) Encourage the student to complete stretches periodically throughout the day

Is the student able to reach objects on the workstation without excessive body extension for long periods of time that is repetitive, or requires trunk/torso deviation?

Reasoning: This will prevent the student from experiencing neck and back strain and fatigue.

Intervention:

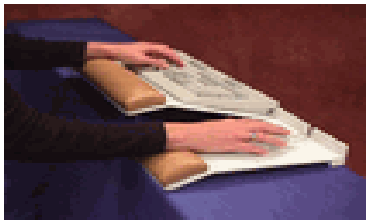
1) Rearrange the computer workstation setup to ensure frequently used objects are near the computer within easy reach
2) Encourage the student to use a document holder when typing from a book or document to avoid head twisting

Is the student able to work in a neutral shoulder position (arms close to their body and relaxed; not abducted out to the side, extended forwards or backwards, raised up, or hunched)?

Reasoning: This will prevent the student from experiencing neck and shoulder strain, pain, and fatigue.

Intervention:

1) Adjust the keyboard and mouse height so the student doesn't have to reach for them. This can be accomplished by purchasing a negative tilt computer tray that allows the keyboard and mouse to be placed on the same level. See picture below.



2) Adjust the student's armrest heights
3) Utilize a chair that is appropriate for the student's size

Are the student's elbows in a comfortable position (elbows close to their body; not abducted out to the side, raised up)?

Reasoning: This will prevent the student from experiencing shoulder and neck pain and fatigue.

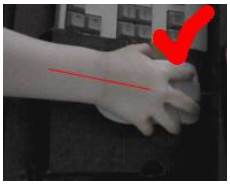
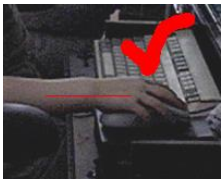
Intervention:

1) Adjust the student's chair armrest height
2) Utilize a chair that is appropriate for the student's size
3) Adjust the keyboard and mouse height so the student doesn't have to reach for them. This can be accomplished by purchasing a negative tilt computer tray that allows the keyboard and mouse to be placed on the same level.

Are the student's wrists in a neutral position (hands in a straight line with their forearms; hands not flexed down towards the palm, extended up towards the ceiling, ulnarly deviated towards their little finger, or radially deviated towards their thumb)?

Reasoning: When the student's wrists are in neutral position, the carpal tunnel is as big as it gets so the median nerve has as much room as possible to move around. This position doesn't create pressure on the median nerve so it decreases the chances of developing a repetitive strain injury to the wrist.

CORRECT

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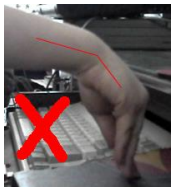


Intervention:

1) Adjust the keyboard and mouse height to discourage wrist flexion and extension
2) If funds are available, purchase a height-adjustable negative slope keyboard tray which will allow the student's wrists to remain in a neutral position
3) Educate and encourage the student to move the mouse with their forearm not just their wrist

Force Static Body Posture

Does the student's workstation design cause them to maintain non-neutral body positions for extended periods of time (30-60 minutes)?

Reasoning: If the student maintains non-neutral body positions for long periods of time, they will likely experience muscle strain, pain, and fatigue in their neck and back.

Intervention:

1) Adjust the student's workstation setup to prevent them from maintaining non-neutral body positions for long periods of time based on the previously mentioned intervention strategies
2) Encourage the student to take frequent rest breaks (every 30-60 minutes)
3) Download ergonomic ErgoPal or ErgoFun on the student's computer to remind the student to take rest breaks

Chair Seat Surface

Is the student's chair seat surface height adjustable, so they are able to sit at a comfortable height that is in relation to their required tasks?

Reasoning: This feature allows the student to adjust the chair to match their size and dimensions. Because not all students are the same size, this feature allows them to individualize their chair height based on their own dimensions.

Intervention:

1) If funds are available, purchase a chair that is height adjustable for a variety of children
2) If the computer desk is too high, place a firm cushion under the child to raise up their seat height
3) Provide books, binders, or boxes for the students to place under their feet to provide them with a stable surface to rest their feet on

Is the student's chair seat the appropriate size for their body (deep and wide enough to comfortably accommodate them)?

Reasoning: If the chair is too large or too small, the student will maintain non-neutral positions which may cause them to fatigue quicker and experience strain and pain throughout their body.

Intervention:

1) If funds are available, replace the seat pan if its too long and doesn't allow the student to sit back fully in the chair
2) If the chair seat is to wide and deep for the student, place pillows behind and beside them
3) Place a lumbar support behind the student's back to decrease the seat depth and provide them with low back support
4) Provide the student with a footrest or other objects (books, binders, boxes) if they can't touch the floor or another stable surface

5) If possible, locate and provide the student with a chair that is adjustable to fit them better

Is the student's chair seat comfortable for them (don't experience pressure on the under side of their legs)?

Reasoning: If the student's chair isn't comfortable, they will maintain non-neutral positions for long periods of time which will cause them to experience strain and fatigue.

Intervention:

1) Educate students on the importance of not using the base of their chair as a footrest
2) Adjust the height of the student's chair so their feet rest flat on the floor
3) Use a footrest to decrease pressure on the under side of the student's legs

Chair Seat Backrest

Can the student adjust the seat height to provide adequate lumbar support?

Reasoning: Using a chair with a seat that is too high may force the student to work with their feet unsupported or encourage them to move forward in their chair to a point where their back isn't supported making it more difficult to maintain the curvature of the spine. These awkward postures may lead to fatigue, pain, and numbness. Adding a lumbar support helps maintain the natural curvature of the student's low back.

Intervention:

1) If the seat can't be lowered, use a footrest to provide the student with stable support for their feet but ensure that it isn't too high
2) If funds are available, purchase a chair that has the adjustable seat height feature

Can the student adjust the seat's backrest angle relative to the seat height?

Reasoning: A chair that doesn't have an adjustable backrest feature will not provide adequate lumbar support or help maintain the natural curvature of the spine. This will increase strain on the student's neck, shoulders, and back.

Intervention:

1) If funds are available, purchase an adjustable chair
2) If funds are available, purchase a lumbar support pad to place behind the student
3) Place a pillow or a rolled-up towel behind the student to support their lower back

Can the student adjust the seat backrest to alter the seat depth?

Reasoning: The seat depth and backrest angle should be adjustable to accommodate the varying postures assumed by the student throughout the day.

Intervention:

1) Teach the student how to adjust their chair
2) Educate the student, parents, and teachers on why it is important for the student to adjust their chair periodically throughout the day
3) Educate teachers and parents about the correct adjustment position.

Is the backrest comfortable for the student?

Reasoning: A good backrest supports the student's back while maintaining normal spine curvature. In addition, a comfortable backrest reduces the likelihood of awkward postures.

Intervention:

1) Place a pillow or a rolled-up towel behind the student to support their lower back
2) Inform parents and teachers that commercial back rests can be purchased from office supply stores to use at home and school

Work Surface

Is the student's workstation width appropriate (all required task accessories and duties are located within comfortable reach and viewing distance)?

Reasoning: If the student has to reach for accessories (i.e. mouse, calculator, etc.), it may cause pain, discomfort, and stress to their arms and shoulders as a result of awkward positions. The closer the accessories are to the student, the easier they are to reach resulting in increased efficiency and productivity.

Intervention:

1) Keep cables and cords concealed, covered, or out of the way to increase workstation space
2) If the area under the workstation is tall and wide enough, place the central processing unit under the student's workstation to increase workstation space
3) If funds are available, purchase a keyboard tray to increase the availability of workstation space
4) If funds are available, purchase corner workstations for the students because they allow the student to place accessories near them
5) If funds are available, purchase a keyboard tray to increase workstation space
6) Educate students, parents, and teachers on the importance of positioning all accessories directly in front of the student
7) Teach students, parents, and teachers about the ergonomically correct way to organize their workstation

Is the student's workstation depth appropriate (computer and keyboard placed directly in front of the student)?

Reasoning: If the computer and keyboard are placed directly in front of the student, it will decrease the amount of eye and neck strain the child experiences.

It will also prevent the student from maintaining awkward positions resulting in fatigue.

Intervention:

1) Keep cables and cords concealed, covered, or out of the way to increase workstation space
2) If the area under the workstation is tall and wide enough, place the central processing unit under the student's workstation to increase workstation space
3) If funds are available, purchase a keyboard tray to increase the availability of workstation space
4) If funds are available, purchase a corner workstation because they provide additional workstation depth
5) Educate students, parents, and teachers about the ergonomically correct way to organize their workstation
6) Teach students, parents, and teachers about the importance of positioning all accessories directly in front of the student

Is the area under the workstation tall and wide enough to accommodate the student's legs, and any other accessories (footrests, arm rests)?

Reasoning: Inadequate clearance under the workstation may result in shoulder, back, and neck pain due to the student sitting too far away from the workstation causing them to reach to perform their computer tasks. In addition, they may experience fatigue, stress, and circulation problems due to constriction of their movement and the inability to frequently change positions.

Intervention:

1) Remove items that are being stored under the workstation
2) If funds are available, purchase a height adjustable workstation to accommodate for different sized students
3) If funds aren't available, insert stable risers such as boards or concrete blocks under the desk legs
4) If the computer workstation has center drawers, remove them to create additional clearance for the student

Computer Monitor

Is the student able to adjust the monitor height easily?

Reasoning: This feature enables the student to adjust the computer monitor to achieve the best viewing angle for them. The computer monitor should be positioned at the student's eye level about an arm's length away from them.

Intervention:

1) If the monitor is not height adjustable, change the height for the student by either adding or removing items (i.e. phonebooks, crates, etc) from underneath it
2) Purchase monitor risers or an adjustable arm if funds are available

3) Teach the student how important it is to adjust the computer monitor height to their level and encourage them to ask their parents or teachers for help in completing this task
4) Educate parents and teachers on the appropriate height computer monitors should be for students

Is the student able to easily adjust the monitor tilt (up/down) angle?

Reasoning: This feature enables the student to adjust the computer monitor to achieve the best viewing angle for them.

Intervention:

1) Mount the computer on an adjustable arm
2) Teach the student how important it is to adjust the computer tilt prior to using the computer and encourage them to ask their parents or teachers for help in completing this task
3) Educate parents and teachers on the appropriate tilt computer monitors should be for students

Is the student able to adjust the monitor's left/right rotational angle?

Reasoning: This feature enables the student to adjust the computer monitor to achieve the best viewing angle for them.

Intervention:

1) Mount the computer on an adjustable arm
2) Teach the student how important it is to adjust the computer monitor's angle to their level and encourage them to ask their parents or teachers for help in completing this task
3) Educate parents and teachers on the appropriate angle computer monitors should be at for students

<u>Keyboard</u>

Is the keyboard detachable from the computer monitor?

Reasoning: If the keyboard is detachable from the computer monitor, it will allow the student to adjust it appropriately so their hands/wrists are in neutral position.

Intervention:

1) Purchase a detachable keyboard for the student's computer

Is the student able to easily adjust the keyboard height?

Reasoning: By adjusting the keyboard height, the student will be able to reduce the stress and strain on their upper back, shoulders, elbows, and wrists. The student's elbows should be at about 90 degrees and their upper arms should be relaxed near the side of their body.

Intervention:

1) If funds are available, purchase an adjustable keyboard tray or lap cat
2) Raise or lower the height of the chair to bring the child nearer to the keyboard height

3) Place a firm pillow/cushion underneath the child to raise them up to the height of their keyboard and provide them with a footrest or additional support for their feet
4) Educate students, parents, and teachers on the importance of adjusting the keyboard height prior to typing

Is the keystroke pressure comfortable for the student?

Reasoning: If the student is applying excessive amounts of force while typing, they may experience discomfort in their wrists and fingers.

Intervention:

1) If parents and teachers have access to additional keyboards, let the student try using a different keyboard
2) Educate the student on using light amounts of force while typing and provide them with opportunities to practice using light touch when keying

Has the student correctly adjusted the keyboard angle so that their hands/wrists are in neutral position when they are typing?

Reasoning: When the student's hands/wrists are in neutral position while keyboarding, their carpal tunnel is as big as it gets so the median nerve has maximum room and injuries can be prevented. Typing in neutral position decreases the chances of developing tendonitis of the hands and wrists as well as carpal tunnel syndrome. Maintaining a neutral hand/wrist position will decrease pain and strain on the student's back, neck, shoulders, hands, and wrists.

Intervention:

1) Educate the student, parents, and teachers on the importance of maintaining neutral wrist position while typing
2) Adjust the students seat height so that their elbows are at the same height as the keyboard
3) If the student's seat isn't height adjustable, place a firm cushion underneath the child to raise them up so their elbows are at the same height as the keyboard
4) Raise or lower the student's workstation so their elbows are at the same height as the keyboard
5) If funds are available, purchase a negative tilt keyboard tray which will assist in positioning the student's hands and wrists in neutral position

Mouse

Is the shape of the mouse and button activation comfortable and easy to use for the student?

Reasoning: The mouse should be designed to fit the student's hand. In addition, the mouse should be as flat as possible to reduce wrist extension. The mouse should be easy to activate because if the student needs to apply excessive force, they may experience discomfort in their fingers and wrists.

Intervention:

1) If funds are available, purchase a flatter mouse that fits the student's hand appropriately
2) Educate the student, parents, and teachers on the importance of using a mouse that is comfortable and easy to activate

Is the student able to reach and operate the mouse without long durations of time, or repetitive reaching with their shoulders, arms, and wrists in neutral position?

Reasoning: The mouse should be positioned directly in front of the student or in a position that is as close as possible to the student so they don't have to reach for the mouse. If the student has to reach for the mouse, it will create strain on the neck, shoulders, and arms.

Intervention:

1) Position the mouse near the student's keyboard on the same plane
2) If the student doesn't use the key-ten portion of their keyboard, place a mouse bridge over the keypad. This simple platform will reduce the need to reach for the mouse.
3) Educate students, parents, and teachers on the importance of positioning the mouse near the child

Is the mouse in a position that can be used within the person's immediate reach zone?

Reasoning: If the mouse is too high or too low, the student will have to continuously reach for the mouse. This position places increased stress on the student's neck, shoulders, and arms. In addition, the student's wrists tend to be flexed or extended instead of neutral wrist position.

Intervention:

1) Move the mouse so it is placed next to the keyboard
2) If the student doesn't use the key-ten portion of their keyboard, place a mouse bridge over the keypad. This simple platform will reduce the need to reach for the mouse.

Document Holder for Data Entry Tasks

Does the student have a special holder or support for their documents?

Reasoning: A document holder allows the student to position documents near the screen, which minimizes the amount of times the student has to turn or twist their head while working. In addition, when documents are laid flat on the workstation surface it results in the student leaning forward and tilting their head downward to see the document. The document should be at the same height or between the computer monitor and keyboard.

Intervention:

1) If funds aren't available to purchase a document holder, prop up the document at an angle between the computer monitor and keyboard
2) Attach a clip to the computer monitor to hold documents

Is the student able to easily adjust the document holder height, distance, and angle?

Reasoning: These features will allow the student to adjust the document holder and place it in a position that reduces the amount of neck flexion, extension, and deviation.

Intervention:

1) Teach the student how to adjust their document holder
2) Educate the student, parents, and teachers on why it is important for the student to adjust the document holder prior to doing computer tasks
3) Educate teachers and parents about the correct adjustment position for the student's document holder

Is the device located in a position that doesn't require the student to twist their head/neck back and forth between the document and screen for long periods of time?

Reasoning: If the document holder is close to the computer screen and at the same level and distance from the student's eyes, it will help the student avoid constant changes in their focus. In addition, it will prevent the student from maintaining awkward trunk and neck positions for long periods of time causing them to experience strain and fatigue.

Intervention:

1) Educate students, parents, and teachers on the importance of positioning the document holder near the computer to prevent head and neck twisting
2) Inform students, parents, and teachers how to reposition the document holder
3) Provide alternative mechanisms for the student to use as a document holder (i.e. attach a clip to the computer monitor or prop up the document at an angle between the computer monitor and keyboard)

Hands and Arm Support

Does the student have padded armrests on their chair or are other padded armrests available?

Reasoning: Armrests reduce postural strain to the upper body, redistribute the weight of the upper body, and reduce forearm exhaustion while typing. Armrests that don't have padding can cause pain or tingling in the student's fingers, hands, and arms.

Intervention:

1) Place a small sheet of foam on top of the chairs armrests
2) If the armrests aren't padded, provide students with access to towels to place on top of their armrests
3) Encourage the student to not use the armrests if they aren't able to locate some form of padding
4) Remove the armrests if they aren't padded
5) If funds are available in the future, purchase chairs that have padded armrests

Are the armrests adjustable (height, lateral positions)?

Reasoning: This will allow the student to adjust the armrests so they don't interfere with their work surface. If the armrests are too high, they will cause the student to elevate their shoulders which could cause pain and stiffness in their shoulders and neck. If the armrests are too low, it will cause the student to slump and lean over to one side. Armrests that are too wide will cause the student to reach with their elbows and bend forward with their body resulting in muscle fatigue in their shoulders and neck.

Intervention:

1) Remove the armrests if they aren't adjustable
2) Replace armrests with adjustable arm rests

Is a broad, flat keyboard palm support available to support the student's hands in neutral position between bursts of typing movements (not a wrist rest because they can put extra pressure on the carpal tunnel)?

Reasoning: A keyboard can be fitted with a palm support which minimizes the amount of contact the student has with the workstation edges and helps keep the student's wrists straight.

Intervention:

1) If funds are available, purchase a flat keyboard palm support
2) Place a towel, thin pillow, or jacket under the student's hands to maintain neutral wrist position
3) Educate the students, parents, and teachers on the importance of maintaining neutral wrist position while typing

Is the palm supported for mouse use?

Reasoning: If the student's palm is supported, it will reduce wrist extension and decrease the risk of developing nerve compression.

Intervention:

1) If funds are available, purchase a flatter mouse that fits the student's hand size.
2) Educate students, parents, and teachers on the importance of supporting their palm when using the mouse

Foot Support

Are the student's feet flat on the floor when they are sitting at their workstation?

Reasoning: If the student is able to rest their feet comfortably on the floor, this will reduce the pressure on the back of their thighs.

Intervention:

1) Purchase a footrest
2) Place books, binders, or a box under the student's feet to provide them with a stable surface to rest their feet on. The student's knees and ankles should be in 90-100 degrees of flexion.

3) Move the computer to a lower surface so the student won't have to sit on as high of a chair which prevents their feet from touching the floor

Is a footrest available if needed?

Reasoning: If the student isn't able to touch the floor comfortably with their feet, a footrest will prevent the student's feet from dangling around. In addition, a footrest will reduce the pressure on the back of their thighs.

Intervention:

1) If funds are available, purchase a footrest
2) If unable to purchase a footrest, place books or binders under the student's feet to provide them with a stable surface to rest their feet on
3) Move the computer to a lower surface so the student won't have to sit on as high of a chair which prevents their feet from touching the floor

Can the student easily adjust the footrest height and tilt?

Reasoning: If the student isn't able to adjust the footrest, they may still experience pressure on the back of their thighs. As a result of this, the student may position themselves in non-neutral and uncomfortable positions.

Intervention:

1) Teach the student how to adjust their footrest
2) Educate the student, parents, and teachers on why it is important for the student to adjust their footrest prior to initiating computer tasks
3) Educate teachers and parents about the correct adjustment position for the student's footrest

Lighting

Are lighting levels appropriate and comfortable for the student when using their computer?

Reasoning: Too much or too little light can inhibit the student's ability to see the task effectively.

Intervention:

1) Dim or turn off overhead lights and use a task light
2) Face dark colored walls when doing computer work
3) Adjust the computer monitor slightly

Is the monitor screen placed appropriately to prevent glare from the windows or overhead lights?

Reasoning: A student's field of vision needs to be free of reflections and sources of glare to ensure that the student can see the details of a task easily and accurately.

Intervention:

1) Hold a small mirror flat against the computer screen to determine what light sources are reflecting off the screen from above or behind
2) Reposition the computer screen so that windows or other light sources aren't creating a glare on the computer screen

3) Adjust the brightness and contrast on the computer monitor to improve the image and reduce flicker
4) Display black characters on a white background to improve contrast
5) Close the curtains or blinds to reduce window lighting
6) If funds are available, purchase a glare screen that can be added to the computer monitor to reduce glare

Are moveable tasks or lights available for the student?

Reasoning: This will allow the student to move to locations where there is the appropriate amount of lighting, and free of reflections and sources of glare. This will ensure that the student can see the details of their task easily and accurately.

Intervention:

1) Educate parents and teachers on the importance of allowing students to choose locations that they feel comfortable working at and then letting them move to those locations to complete tasks

Do windows have curtains, drapes, or blinds to block light where glare from the source is a problem?

Reasoning: A student's field of vision needs to be free of reflections and sources of glare to ensure that the student can see the details of a task easily and accurately.

Intervention:

1) Hold a small mirror flat against the computer screen to determine what light sources are reflecting off the screen from above or behind
2) Reposition the computer screen so that windows or other light sources aren't creating a glare on the computer screen
3) Close the curtains or blinds to reduce window lighting
4) If funds are available, purchase a glare screen that can be added to the computer monitor to reduce glare

Does the student's work surface have a dull finish to reduce light reflection?

Reasoning: Glossy work surfaces and furnishings contribute to glare, so dull finish surfaces will ensure that the student can see the details of a task easily and accurately.

Intervention:

1) Paint the work surface a dull color to reduce glare
2) Place a dull colored table cloth over the work surface

Temperature

Is the student comfortable with the room temperature?

Reasoning: If the room temperature isn't regulated appropriately, it can cause the student to feel uncomfortable and reduce productivity levels. If the room is too cold, the temperature can cause decreased flexibility, dexterity, and judgment. In addition, cold temperatures increase the risk of muscle strain occurring. High temperatures can been associated with fatigue, irritability, headaches and

decreased performance, coordination, and alertness. Frequent accidents may occur due to extreme temperatures.

Intervention:

1) Educate school personnel on the impact extreme temperatures have on students
2) Educate students on the importance of dressing appropriately and encourage them to bring additional articles of clothing if they feel cold during school

Is the student comfortable with the temperatures of the equipment or surfaces that they contact?

Reasoning: If the equipment or surface temperatures aren't regulated appropriately, it can cause the student to feel uncomfortable which will reduce their productivity.

Intervention:

1) Educate students, parents, and teachers about appropriate equipment temperatures
2) Encourage students to tell their teachers or parents if equipment is too hot or cold

Vibration

Does the student experience any uncomfortable keyboard vibrations?

Reasoning: Vibration increases the risk of injuries developing.

Intervention:

1) Encourage the student to take frequent rest breaks
2) Educate the students on the importance of telling their teachers or parents about the vibrations

Noise

Are sound levels at a comfortable level, easily allowing for conversation and communication with peers or attention to their task?

Reasoning: Working in uncomfortably loud environments, stresses the body causing the student's muscles to tense up accelerating the likelihood of developing injuries.

Intervention:

1) Install acoustic pads under keyboards and printers
2) If funds are available, install carpet, upholstery, or drapes to help control noise levels
3) Have the computer area be a quiet zone for students
4) Wear earplugs

Ventilation

Is the air circulation sufficient for the student?

Reasoning: Sufficient air circulation contributes to a good learning environment and it is important for maintaining good health.

Intervention:

1) Encourage parents and teachers to open up windows to allow fresh air into the room
2) Utilize a humidifier, dehumidifier, or an air purifier to regulate air circulation
3) Educate students, parents, and teachers on the impact air circulation have on the student's learning
4) Encourage students to tell their teachers or parents if they are uncomfortable due to the air circulation

Is the air quality satisfactory?

Reasoning: Good air quality contributes to a good learning environment. In addition, poor air quality can potentially have a negative effect on student's health.

Intervention:

1) Encourage parents and teachers to open up windows to allow fresh air into the room
2) Utilize a humidifier, dehumidifier, or an air purifier to regulate air conditions
3) Educate students, parents, and teachers on the impact air conditions have on the student's learning
4) Encourage students to tell their teachers or parents if they are uncomfortable due to the air quality conditions

Is the air too dry or too humid?

Reasoning: When the air is too humid, it makes people feel uncomfortable (i.e. wet and clammy). Low humidity conditions dry out the nasal and respiratory passages, which may be associated with increased susceptibility to upper respiratory infections. The room should maintain 30-60% relative humidity.

Intervention:

1) Encourage parents and teachers to open up windows to allow fresh air into the room
2) Utilize a humidifier or dehumidifier to regulate air conditions
3) Educate students, parents, and teachers on the impact air conditions have on the student's learning
4) Encourage students to tell their teachers or parents if they are uncomfortable due to the air quality conditions

Fatigue Control

Is the student allowed to take rest breaks from tasks that require long duration (30-60 minutes), repetitive postures, or excessive keying or mousing activities?

Reasoning: Rest breaks give student's muscles a chance to rest that they have been using for long periods of time to complete the task. A rest break will give students a chance to use other muscle groups that haven't been used while completing their task. A rest break will prevent students from fatiguing quickly and it will increase circulation to their muscles and other tissues.

Intervention:

1) Set a kitchen timer as a reminder for the student to get up and move around every 30-60 minutes
2) Download ergonomic ErgoPal or ErgoFun on the student's computer to remind the student to take rest breaks
3) Encourage students to exercise their eyes and body periodically while working on the computer or at their workstation
4) Educate parents and teachers on the importance of rest breaks and why students need to be allowed to take frequent breaks
5) Educate students on the importance of maintaining good postures throughout the day

Vision

Is the student experiencing eye strain, burning sensation, blurred vision, or headaches?

Reasoning: These are symptoms that the student may experience as a result of extensive viewing of the computer screen.

Intervention:

1) When students are using the computer, encourage them to take a 10 minute rest break every hour
2) Adjust the computer monitor height or the chair height
3) Reposition the computer so that windows or other light sources aren't creating a glare on the computer screen
4) Close the curtains or blinds to reduce window lighting
5) Reduce the amount of lighting in the room to match the computer screen by substituting a smaller light for a bright overhead light or use a dim switch to allow for flexible control of the room lighting
6) Encourage the student to do eye exercises every 30-60 minutes or when they begin experiencing eye strain, burning sensations, blurred vision, or headaches

If the student is experiencing these issues have they had a recent eye exam/screening?

Reasoning: A vision screening will ensure that the student can see clearly and comfortably. In addition, it will detect any hidden conditions that may contribute to eyestrain.

Intervention:

1) Educate students on the importance of telling their teachers and/or parents when their eyes are hurting

Psychosocial Issues

Is the computer software "user friendly" for the student?

Reasoning: If the software isn't "user friendly", the student will get frustrated more easily resulting in feelings of inadequacy. If the software is "user friendly", the student will be satisfied with the software resulting in increased productivity.

Intervention:

1) Encourage students to tell their parents and teachers if they are experiencing difficulty with the computer software
2) Educate school personnel and parents on the benefits associated with "user friendly" software
3) If funds are available, encourage school personnel and parents to purchase new software that is more "user friendly" for students
4) Provide students, parents, and teachers with adequate training on the software to prevent feelings of inadequacy and frustration

Backpack Features

Does the student's backpack have wide, padded straps?

Reasoning: A backpack with wider, padded straps helps distribute the backpack load better, resulting in less stress in any one area.

Intervention:

1) Educate parents on the importance of having a backpack with wide, padded straps to distribute weight better
2) Provide the student's parents with information about where they could purchase materials to make the student's backpack straps wider with additional padding
3) Notify the student's parents about where they can purchase additional padding at and wider strapping material (i.e. local supply stores)
4) If funds are available, have the student's parents purchase a new backpack with wider, padded straps

Does the student's backpack have a waist belt?

Reasoning: A waist belt takes pressure off the student's neck and shoulders especially if they are carrying heavy backpack loads. In addition, waist belts remove stress from the student's lower back region.

Intervention:

1) Educate students on the importance of using their waist belt if their backpack has one
2) Inform the student's parents on the importance of purchasing a backpack with a waist belt and using it appropriately

Does the student's backpack have good padding on the area that rests against their back?

Reasoning: A backpack with good padding will prevent textbook and binder edges from cutting into the student's skin on their back and underneath their arms.

Intervention:

1) Inform the student's parents about the option of adding additional padding or foam to the inside of the student's backpack
2) Notify the student's parents that they can purchase additional padding from local supply stores
3) If funds are available, have the student's parents purchase a new backpack with good padding

Correct Use of Backpack

Is the student's backpack worn on both of their shoulders?

Reasoning: If the student carries their backpack on one shoulder, it puts more stress on one side of their body than the other.

Intervention:

1) Educate students on the importance of carrying their backpack on both shoulders
2) Implement a reward system for the students to encourage them to carry their backpack on both shoulders
3) Inform the student's teachers and parents on how to wear a backpack properly to ensure that the students are wearing their backpacks properly
4) Inform the student's parents about the option of purchasing a rolling backpack to prevent students from having to carry a heavy backpack

Is the student wearing their backpack high on their shoulders (bottom shouldn't rest more than 4 inches below student's waistline and shouldn't be higher than the student's upper shoulder blades)?

Reasoning: If the student's backpack is positioned high on their shoulders or below their waistline, it will cause strain on their back.

Intervention:

1) Educate the student on how to wear their backpack properly to decrease the amount of back strain associated with backpack use
2) Inform the student's teachers and parents on how to wear a backpack properly to ensure that the students are wearing their backpacks properly

Does the student's backpack fit snuggly against their back?

Reasoning: The closer the student wears their backpack to their body, the less strain they will feel while carrying their backpack.

Intervention:

1) Educate the student on how to wear their backpack properly to decrease the amount of back strain associated with backpack use

2) Inform the student's teachers and parents on how to wear a backpack properly to ensure that the students are wearing their backpacks properly

Is the student using the waist belt?

Reasoning: If the student is going to be carrying a heavy load, by wearing the waist belt it will take pressure off their neck and shoulders.

Intervention:

1) Educate the student on the importance of using their waist belt every time they put their backpack on
2) Inform the student's teachers and parents on how to wear a backpack properly to ensure that the students are wearing their backpacks properly

Backpack Weight

Does the student's backpack weigh more than 15% of their body weight?

Reasoning: By carrying backpacks that weigh too much, students will experience neck, shoulder, and back pain resulting in adverse effects on their posture and spine. In addition, it can result in compromised breathing and fatigue.

Intervention:

1) Educate students on the importance of cleaning out their backpacks regularly and only carrying the items that are required for class that day
2) Inform school personnel, teachers, and parents to purchase light-weight notebooks and binders (ones made out of plastic)
3) If funds are available, purchase one set of textbooks for home and another set to use at school
4) Encourage teachers to provide students with adequate time to go to their lockers between classes
5) Encourage teachers to give explicit directions about what materials students need to bring to class each day and clarify assignment due dates to prevent carrying excessive materials
6) If lockers aren't available, persuade teachers to provide the students with classroom storage boxes to store books, supplies, and athletic equipment
7) Encourage students to carry different backpacks for different activities
8) If lockers aren't available, educate school personnel on the dangers associated with carrying heavy backpacks

Resource List

Workstation Ergonomic Guidelines for Computer Use by Children

5) http://www.ergoworksconsulting.com/Articles/ChildrenErgonomics.html
6) http://ergo.human.cornell.edu/cuweguideline.htm
7) http://ergo.human.cornell.edu./MBergo/schoolguide.html
8) http://www.education.umn.edu/kls/ecee/guidelines.html

Backpack Ergonomic Guidelines for Children

4) http://ergo.human.cornell.edu./MBergo/schoolguide.html
5) http://www.aota.org
6) http://www.newton.mec.edu/day/backpack.html

Children and Vision

3) http://www.aoa.org
4) http://www.nei.nih.gov
5) http://www.opticalinternet.com

Child Injury Prevention

6) http://humanics-es.com/recc-child.htm
7) http://www.cdc.gov
8) http://www.cpsc.gov
9) http://consumerreports.com
10) http://cpsc.gov/neiss

Education Section

This section of the protocol contains information that will assist an occupational therapist in educating other healthcare professionals including OT's, school personnel, parents, and children on the benefits of ergonomics. This section of the protocol will help OT's educate others on the benefits of incorporating ergonomic strategies at school and home. Hopefully through educating school personnel, parents, and children on these areas, it will guarantee a change in poor ergonomics with follow through at home and school to correct their poor habits.

This section contains a sample workshop outline and educational handouts on backpack safety, school furniture/workspace design, and computer use.

Sample Workshop Outline

The sample workshop outline included in this section can be used by OT's as a guide when determining what topics to cover when educating other OT's, school personnel, parents, and children on the benefits of ergonomics. The information covered in the sample outline is based on the literature findings and it can be modified dependent on the needs of the population that you are educating. The areas covered in the sample workshop outline include ergonomic terminology and the 3 domains of specialization; the role of OT; the benefits of using ergonomics with adults; the risk factors, injuries, and disorders as a result of poor ergonomics; the child's needs in relation to the 3 domains of specialization; the child's risk factors due to poor ergonomics; and the benefits of using ergonomics with children. Also, the sample workshop outline recommends teaching devices and materials, ways to apply newly acquired skills and knowledge, and evaluation tools.

Educational Handouts

In addition to the sample workshop included in this section, educational handouts are provided to assist in educating school personnel, parents, and children regarding backpack safety, school furniture/workspace design, and computer use. The handouts are specific for each group that the OT will be educating. Each handout describes why it is important for the specific group to implement ergonomic strategies in these areas. The handouts also provide the specific group with additional keywords to use to search the Internet to find out more information on the specific topics. The handouts are user friendly and include pictures to ensure that the specific groups comprehend what the OT is educating them on.

Sample Workshop Outline
Ergonomics and the School-Aged Child

This is a sample workshop outline based on my literature findings. This sample outline can be modified to meet the specific needs of the population that you are educating.

Objective

~ Demonstrate an increased ergonomic knowledge base and skill level by applying ergonomic techniques to children and their workstations, computer usage, and backpacks.

Sequence of workshop content

1. Ergonomics terminology
2. Role of OT when applying ergonomic techniques
3. Description of the 3 ergonomic domains of specialization
    a. physical
    b. cognitive
    c. organizational
4. Benefits of using ergonomics with adults
5. Resultant risk factors, injuries, and disorders due to poor ergonomics
    a. work-related musculoskeletal disorders
    b. cumulative trauma disorders
    c. computer vision syndrome
6. Identify child's needs in accordance to the 3 ergonomic domains of specialization
7. Child's risk factors due to poor ergonomics
8. Benefits of using ergonomics with children
9. Examine poor ergonomic situations and identify ways to improve these situations with ergonomic techniques learned through the workshop

Teaching devices and materials

1. Power point presentation on workshop content
2. Examples of poor ergonomics (pictures obtained from previous work experience, Internet, etc)
3. Handouts on ergonomic techniques to be used with children, their computers, workstations, and backpacks

Application of new skills and knowledge

In small groups, evaluate examples of poor ergonomics and identify appropriate interventions to improve the scenarios. Share and discuss findings with the large group.

Evaluation Tools

Test skills and knowledge through application and a 10 point "quiz".

Tips for Parents and/or Teachers
To Improve Students Computer Use

The computer is going to be an important tool in students' lives. Parents and teachers need to pay special attention to how the computer is introduced to make sure that students learn useful strategies on how to organize their workstations and develop good work habits. Understanding and implementing ergonomic principles (fitting the workplace to the worker i.e. child) is a critical piece in this learning process and need to be incorporated into all aspects of computer use both at school and home. By applying these strategies at home and school, current and future injuries can be prevented.

Keywords to search the Internet for additional information:

Child & ergonomics
Child & computer workstations

Ergonomic Principles

- Position the student in relation to the keyboard/mouse height and place the mouse next to the keyboard so it is easy for the student to reach. If the keyboard and mouse are too high or too far away, the student will have to reach for these objects. This posture will place increased stress on the student's shoulders and neck tissues. This may also cause the student to bend their wrists.

CORRECT

INCORRECT

- Position the mouse and keyboard so the student's wrists are straight when they are typing and using the mouse. If the mouse is too far away from the keyboard or to high or to low in comparison to the keyboard, the student will have to reach for the mouse which may cause their wrists to bend up, down, or to the side. This may result in increased strain and stress on the student's shoulder, neck, and wrist.

CORRECT

INCORRECT

- Place the computer monitor directly in front of the student so they don't have to twist their neck to view the screen. This will prevent the student from experiencing neck and shoulder pain as a result of twisting their neck to see the computer monitor.

CORRECT

- Position the top of the computer screen below the student's eye level. This will prevent the child from having to hold an awkward neck posture while looking up at the computer screen. In addition, it will prevent children from experiencing strain on their neck and upper body due to arching their back and raising their chin to clearly see the computer screen.

CORRECT

INCORRECT

- Encourage the student to change their position every 15-20 minutes (use a kitchen timer as a reminder for the students). This will prevent the student from becoming uncomfortable due to maintaining the same position for a long period of time. By changing positions frequently, it will help reduce stress and redistribute pressure associated with maintaining the same posture for a long period of time.
- Promote the student to get up and move around every 30-60 minutes. This will give the student's muscles a chance to rest that they have been using to type and focus on the computer screen and also give the students a chance to use other muscle groups. This will prevent the student from fatiguing quickly. In addition, this helps increase circulation to the student's muscles and other tissues.

Adapted from International Ergonomics Association (2003)

Tips for Parents and/or Teachers
Computer Workstation Furniture and Equipment

Thousands and thousands of dollars are spent by school districts and families on computers, software, and games but they often forget that it is also important to spend money on the workstations the students use. Workstations are where the child sits for a considerable amount of time and without addressing this area, a child could experience problems over the long run. By purchasing quality and well fitting workstation furniture and equipment, current and future injuries can be prevented!

Keywords to search the Internet for additional information:

Adjustable computer chair
Adjustable computer workstations
Child & computer workstations

Ergonomic Furniture and Equipment

- Purchase an adjustable, stable workstation especially if adults and children are going to be sharing the workstation. This will allow for different sized users to adjust the workstation appropriately, so the height of the workstation matches their size and that they can use it comfortably. In addition, the workstation surface should be large enough to support all of the computer supplies, books, documents, tools, telephone, etc.

- Purchase an adjustable and comfortable ergonomically correct chair that has height, weight, and back support adjustment mechanisms. These features will allow the child to adjust the chair to match their size and proportion. If purchasing an adult sized chair, the chair will have to be further adjusted to meet the child's needs based on their size. The adjustable height feature is important because the child's feet always need to touch the floor or another hard surface such as a footrest, book, etc. In addition, adjustable back supports are important because this feature will protect the child's natural lower back curve and prevent incorrect kyphotic postures.

- Look for a height-adjustable negative slope keyboard tray (see picture below) that helps keep the child's elbows at a >90 degrees and allows their wrists to remain in neutral position. The negative tilt keyboard tray will put the child's hands in a position that is below their elbows. This position will allow their hands and wrists to be in a neutral position. In addition, this tray will discourage the child from resting their wrists on the desktop which will minimize compression on their forearms.
- Purchase a height-adjustable, gliding mouse platform that allows the mouse to be close to the child's body, above the keyboard tray so that their arms don't have to reach to the sides. This feature will prevent the child from having to strain their arm to reach the mouse because it is close to them.

- Buy a computer monitor that is height and angle adjustable. This will allow different sized users to adjust the computer monitor appropriately to match their height. This will prevent the child from straining their neck and upper back in order to see the computer screen whether it is too high or too low.

- Position the computer monitor at a comfortable distance for viewing, which is usually about an arms length away. If the computer is too far away, the child may bend their neck backwards or stick their chin out so that they can view the computer. By placing the computer at a comfortable distance from the child, it will limit the strain on their neck.
- Place the computer directly in front of the child's eyes, about 16 to 18 inches away from them, to prevent the student from rotating their neck to see the computer screen.
- When using the computer, the child's eyes should be in line with a point that is 2 to 3 inches below the top of the computer monitor. This will prevent neck pain from occurring.

Adapted from Cornell University Ergonomics Web (2000)

Backpack Awareness Strategies for Schoolchildren

How to carry your backpack right

- Wear your backpack on both shoulders
- Adjust the shoulder straps so the backpack fits snugly on your back
- Wear the backpack's waist belt if it has one

Ways to decrease backpack loads

- Your backpack's weight shouldn't weigh more than 15 percent of your weight
- Pack your backpack with the heaviest items at the back
- Carry a book to class if your backpack is to heavy
- Buy light weight notebooks and binders
- Only carry the items that are needed for class that day

Adapted from American Occupational Therapy Association, Inc (2002) and Backpack Awareness Checklist (n.d.)

This coloring picture handout will be used to educate children ages kindergarten through second grade on backpack awareness.

The American Occupational Therapy Association offers backpack information at www.aota.org

Backpack Awareness Strategies for Parents of Schoolchildren

Parents play a vital role in backpack safety. They go shopping with their children to select a backpack and pay special attention to what is being brought home in their children's backpack. Through proper education on backpack safety, parents can take appropriate steps when assisting their children in loading their backpacks each day. In addition, they can implement proper strategies to ensure that their children are wearing their backpacks correctly to prevent and avoid health problems.

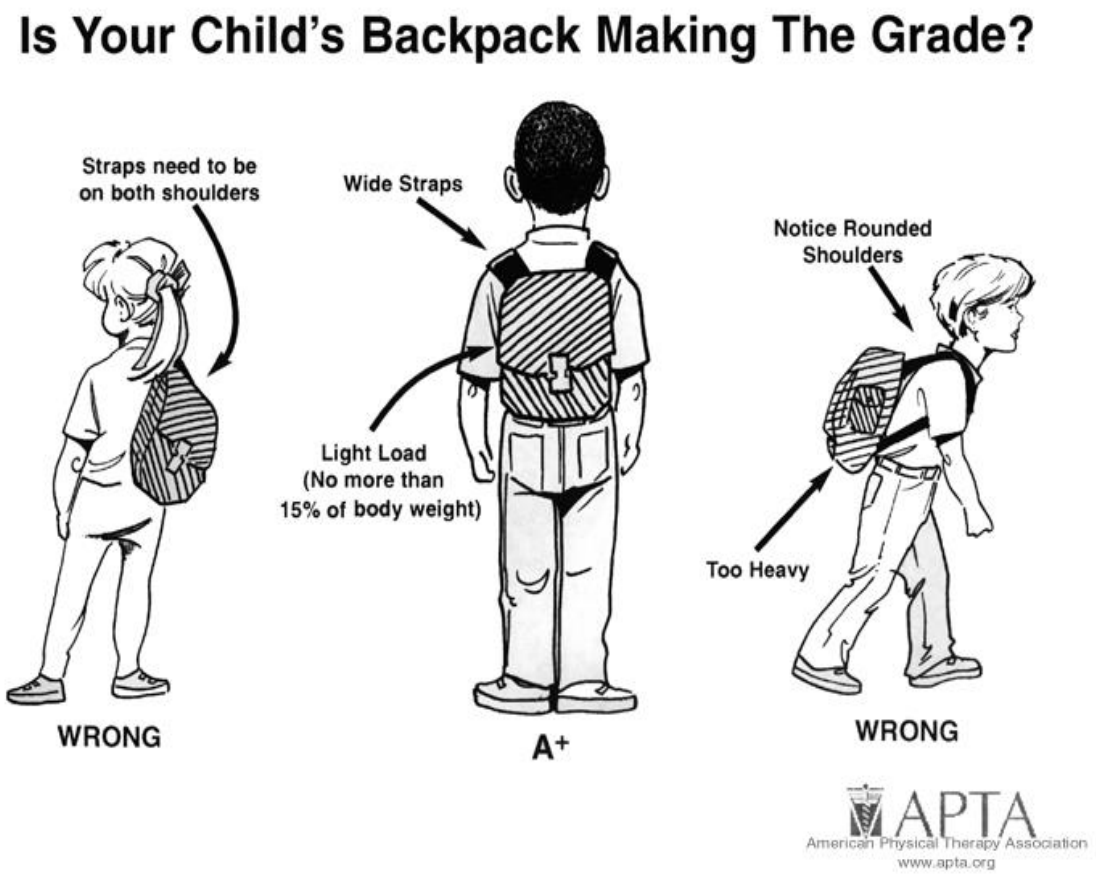
Keywords to search the Internet for additional information:

Backpack Awareness
Effects of Heavy Backpacks
Backpacks and Children

Strategies for Parents

- Purchase a backpack, not a sports bag or other carry bags, with padded straps and backpack that has a waistband. The padded straps help distribute the backpack load better, resulting in less stress in any one area. The waist belt takes pressure off of your student's neck and shoulders especially when carrying a heavy backpack load. In addition, the waist belt removes stress from your child's lower back region.
- Select the right size backpack for your child's back as well as one that has enough room for all of their necessary school items
- Avoid purchasing a large backpack with many compartments for your child. A large backpack with many compartments will encourage your child to store more items in their backpack to prevent it from looking empty.

- Check to see that children are wearing their backpacks correctly
- Assess children's backpack weight periodically to evaluate if it weighs more than 10-15 percent of their body weight



Adapted from American Occupational Therapy Association, Inc (2002), Backpack Awareness Checklist (n.d.), and American Physical Therapy Association (2004)

Backpack Awareness Strategies for Teachers

Children's work environment is primarily the school environment for at least 9-10 months out of the year on an average of seven hours per day. A child's work occurs within a variety of roles such as a student or an athlete and through various work activities such as doing homework, using a computer, or playing a school sport. Because of the amount of time students spend at school, teachers can play very influential roles in student's education. The following are recommendations on ways teachers can help decrease the loads students are carrying in their backpacks.

Keywords to search the Internet for additional information:

Backpack Awareness
Effects of Heavy Backpacks
Backpacks and Children

Strategies for Teachers

- Give students explicit directions about what materials they need to bring to class each day based on the unit and subjects to prevent carrying excessive materials
- If the school has an Internet site, post what textbooks, binders, or other materials are needed for specific days the week so parents can help their child pack their bags accordingly
- If the school doesn't have an Internet site, send home a checklist for parents each Friday so they know what materials their child needs to bring to class for the upcoming week
- Clarify assignment due dates for the students so they aren't carrying around extra assignments
- If feasible, provide students with two sets of textbooks so they can leave a copy of the book at home and school
- If possible, post class materials online and/or make photocopies of homework assignments for the students so they don't have to carry around all of their textbooks
- Analyze the students notebooks and binders to determine if there is lighter options that they could use to decrease their backpack loads
- Allow students reasonable amounts of time between classes to go to their lockers to get class materials and supplies for the next class
- Provide students with storage compartments to store books, supplies, and athletic equipment if lockers aren't available to students
- Encourage students to carry different backpacks for different activities

Survey Section

This section of the protocol contains a sample survey that an OT can use as a guide to measure the success of the tools they implemented. This survey is designed to assess the parent and/or teacher satisfaction of the implementation of this protocol. The sample survey contains eight questions that focus on the usability of the ergonomic information within the protocol. In addition, there are nine more questions that allow the parents and teachers to rate the success of the protocol information/education based on the student's complaints, concerns, or comments.

The questions addressed through the sample survey are based on the literature findings and it can be modified dependent on the needs of the population that you are surveying. It is important to note that this survey is not standardized. This is a simple survey tool designed to initiate the process of gathering evidenced based outcomes for the protocol to identify effectiveness, usefulness, efficiency, and needs.

Survey
Usability of Ergonomic Information

Please take a few minutes to complete this survey by circling the number that corresponds with your level of satisfaction and/or success with this OT protocol. The survey results will be used to begin the process of gathering evidenced based outcomes to improve the ergonomic intervention process for the students. Please use the following scale to rate your satisfaction:

4/Exceeds Standards **3/Meets Standards**
2/Needs Improvement **1/Unsatisfactory**

Overall, the protocol material was useful and appropriate	4	3	2	1
All of the sections were easy to understand and follow If not, please specify:	4	3	2	1
The implementation reasonings were logical and helped me to understand why each area needed to be addressed	4	3	2	1
The intervention strategies were understandable If not, please specify:	4	3	2	1
The intervention strategies were easy to implement If not, please specify:	4	3	2	1
The resource list assisted me in finding additional resources regarding school-age children and ergonomics	4	3	2	1
I understand the educational handouts and how to use them	4	3	2	1
The educational handouts were useful tools to use when educating parents, teachers, and children on backpack safety, school furniture/workspace design, and computer use If not, please specify:	4	3	2	1

Additional comments, concerns or suggestions:

Survey
Student Specific Ergonomic Needs

Please take a few minutes to complete this survey by circling the number that corresponds with your level of satisfaction and/or success with this OT protocol. The survey results will be used to begin the process of gathering evidenced based outcomes to improve the ergonomic intervention process for the students. Please use the following scale to rate your satisfaction:

4/Always **3/Occassionally**
2/Rarely **1/Never**

Do students complain (1-2x/week) about backaches while using the computer?	4	3	2	1
Do students complain (1-2x/week) about backaches while sitting at their workstation?	4	3	2	1
Do students complain (1-2x/week) about backaches while carrying their backpack?	4	3	2	1
Do students complain of eyestrain, headaches, or blurred vision due to prolonged computer use?	4	3	2	1
Do students demonstrate any of the following: rubbing their eyes, staring off, losing attention to task, putting their head down etc…when working on the computer for 30-60 minutes?	4	3	2	1
Are students maintaining awkward positions for long periods of time (30-60 minutes)?	4	3	2	1
Are students adjusting their postures every 10 minutes or so when working on the computer?	4	3	2	1
Are students adjusting their workstations prior to using the computer?	4	3	2	1
Did this protocol assist you in making ergonomically correct adaptations to student's:				
workstations,	4	3	2	1
backpacks, and	4	3	2	1
computers	4	3	2	1

Additional comments, concerns, or suggestions:

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CHAPTER FIVE

SUMMARY

Since work can be viewed as almost any kind of human activity which involves purpose of effort, then wherever there is a person in an environment, ergonomic principles can be applied. Because a child's work occurs within a variety of roles such as a student or an athlete and through various work activities such as doing homework, using a computer, or playing a school sport, ergonomic principles need to be applied to the child's work environment, the classroom. Children are at risk of experiencing the same risk factors, injuries, and disorders as adults. This supports the need for implementing ergonomic principles at a young age, so children will be able to develop life-long strategies that will prevent injuries and/or disorders in the future.

Clinical Implications

The OT protocol would be a valuable asset to the profession of occupational therapy. It would assist in preventing risk factors, injuries, and disorders in a child's work environment since many of the risk factors affecting the adult workforce are similar to the risk factors affecting children, and the benefits of ergonomics for adults are the same for children, just in different aspects. The profession of occupational therapy needs to begin placing more emphasis on this aspect considering the short and long term implications.

Limitations

1. The protocol is generalized for all school-aged children. This is a limitation because every child is different developmentally and has different ergonomic needs.

Recommendations

1. To meet the individual needs of each child or the specific needs of the population, it is recommended that the protocol be modified to ensure maximum benefit.
2. It would be beneficial to modify this protocol based on clinical experience in combination with current reviews of the literature.
3. Ergonomics is not an entry-level specialty for occupational therapists. Continued education, training, and practice are essential to gain expertise and credibility in the field of ergonomics.
4. The OT Pediatric Special Interest Section should consider spending more time on research and implications of this emerging area of practice. It should be incorporated into pediatric courses at an introductory level at minimum.

In conclusion, many of the risk factors affecting the adult workforce are similar to the risk factors affecting children, indicating that the benefits of ergonomics for adults are the same for children, just in different aspects. The proposed OT protocol would be a valuable asset in preventing risk factors, injuries, and disorders in a child's work environment. The profession of OT needs to take a proactive, preventive approach to educate and communicate to others the need for implementing ergonomic principles at a young age. It is imperative that the children's health be protected for their own sake as well as for the stability of the future socioeconomic environment.

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